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USER GUIDE

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Anatel

A-100
ORGANICS ANALYZER

USER GUIDE

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A-100 User Guide
Part No. FG/57000-04

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ANATEL A-100 SE ORGANICS ANALYZER
VERSION 3.14 SOFTWARE UPDATE

October, 1990

This update to the Anatel Corporation *A-100 Organics Analyzer User Guide* (P/N FG 57000-04) documents changes which were incorporated in Version 3.14 of the instrument's software. These changes include new specifications for the operating parameters, minor changes in the printout format and an improvement to the trend calculations and display.

The affected section and page number are given where applicable and appropriate notes should be made in the *User Guide*. Also refer to the Version 3.12 Software Update for additional changes and information.

1.2 THE ANATEL A-100 ORGANIC CARBON ANALYZER *(Page 1)*

The A-100 SE is capable of detecting TOC levels between 0.05 and 9999 ppb TOC (parts per billion of Total Organic Carbon) as carbon and by weight. Tests have been conducted with the lowest obtainable TOC level at less than 0.3 ppb and analyses of this data confirms both the method and the theory. All measurements in 5 Megohm-cm or higher resistivity water are extremely accurate for organics containing nothing other than hydrogen, oxygen and carbon. Organics containing significant levels of hetroatoms (such as halogens, sulfer or nitrogen) will exhibit elevated TOC readings. For low to moderate levels of hetroatoms (up to 20% by molar ratio), the value indicated is roughly equivalent to that which would be expected from a substitution of a carbon for each hetroatom. Greater proportions of hetroatoms, particularly high levels of halogenated organics, can have a more significant effect. Measurements taken on water containing less than 100 ppb oxygen (oxygen-free) may have limited accuracy when in excess of 1000 ppb TOC, depending on the nature of the organics.

1.4 SPECIFICATIONS *(Page 3)*

Refer to the Section 1.2 update above for a general discussion of the A-100 SE's TOC range and accuracy.

1.4.1 Environmental Characteristics *(Page 3)*

Sample Water —

Temperature:	54°F to 104°F (12°C to 40°C)
Pressure:	
Standard:	15 to 100 psi (1.0 to 7.0 kg/cm^2)

1.4.2 Performance Characteristics *(Page 3)*

Measurable Range:	0.05 to 9999 ppb TOC
Repeatability:	Better than 0.05 ppb below 5.0 ppb or 1% above 5.0 ppb
Resolution —	
Less than 20 ppb:	0.01 ppb
Less than 100 ppb:	0.1 ppb
100 ppb or Greater:	1.0 ppb

2.4 START-UP *(Page 10)*

The A-100 initially will present "A100" on its display panel. After system initialization, a series of processor, coprocessor, memory and non-volatile memory tests are performed. Once system integrity has been determined, the Controller's *Test* LED will flash, "SE" is displayed and the communications link with the instrument's Sensor Compartment is established. If the optional printer is installed, its heading also will be written at this time.

If a problem is detected during the memory or processor tests, the *Error* LED will illuminate when the *Test* light comes on. Refer to Section 6.2 in the A-100 *User Guide* for a listing of error codes and their explanations. The Controller will continue to display "SE" and the *Test* light will flash should communications with the Sensor Compartment be the source of the problem. Additionally, a "100" error will be printed assuming this optional device is installed. In this case, connections from the Power Supply to the Sensor Compartment should be checked, particularly if it is a new installation.

CAUTION: TURN POWER TO THE A-100 "OFF" AND DISCONNECT THE POWER CORD BEFORE EXAMINING ANY CONNECTIONS.

3.3 DEFAULT VALUES *(Page 12)*

Once altered, a factory default value may be restored by depressing the appropriate key to access the function, then pressing it again and holding it until the default is displayed (about three seconds). The default value can be modified using the normal "scrolling" method. The value is only displayed; as with any changes, the **Enter** key must be depressed to save it into program memory. Pressing **Clear** will exit the function without altering its value.

The default values for all listed parameters can be installed by turning power to the A-100 SE "Off" and then holding the **Dual Down Arrow** key while restoring power. The key must be held down for at least one-half a second after the "A-100" is displayed. The display will blank momentarily before reinitializing if this procedure is performed properly. This procedure also enables the printer output and reports that the parameters have been changed for the serial interface (see Section 7.2.1).

3.4 TIMING INTERVALS *(Page 13)*

TREND MODE

The trend value is now calculated through the use of an exponentially weighted running average, a filter which allows averages and standard deviation operations to be simulated in real time. The set trend time determines the interval used for this calculation. A trend time of "0" will calculate the real slope between consecutive readings. Generally, the chosen trend time should be on the order of 2-10 analysis cycles for quick response and realistic stability. The trend value will not be printed or reported by the corresponding arrow following power-up or a system reset until a period of at least one-half of the specified trend time has elapsed.

3.6 CALIBRATION *(Page 14)*

Anatel's Customer Service and Support Organization (CSSO) provides on-site or in-house calibration/verification of the A-100 SE. Contact the CSSO department for more information.

3.7 SPECIAL FUNCTION PARAMETERS *(Page 15)*

To access the Special Functions Mode press the **Dual Up Arrow** key and continue to hold it down while the power is turned on for at least one-half second after "A-100" is displayed. The row of LEDs beneath the numeric portion of the display will illuminate to indicate the Special Functions Mode has been accessed.

3.7.2 Analog Output *(Page 16)*

FULL-SCALE ANALOG OUTPUT

The full-scale analog output function is used to alter the output range of the analog signal. The full-scale setting is determined by the value entered, as for maximum TOC in ppb; the minimum value is always "0." For example, if the standard 4-20 mA interface is used and a full-scale setting of 500 ppb is entered, a reading of 250 ppb would produce a 12 mA output. Values above the full-scale setting yield the maximum (full-scale) output. Resolution in the 4-20 mA mode is 1:3276; in the 0-5 VDC mode the resolution is 1:4095.

The behavior of the output during periods of interrupt level errors is programmable. After exiting, entering or clearing the full-scale value, the instrument will allow the "output level during interrupt errors" to be set. To return to Special Function Mode, press either the **CLEAR** or the **CAL** key.

OUTPUT LEVEL DURING INTERRUPT ERRORS

The analog output can react in one of three manners after encountering an interrupt error (see Section 6.2 in the *User Guide*). This response can be set after accessing the full-scale analog output (by **ENTER**ing a value or pressing **CLEAR** or **CAL**) as follows:

1) Access the full-scale output mode.
2) Press **CLEAR** or **CAL** to advance to the output level set.
3) Enter one of the following values:
   0 — Analog output level will go to "0" (minimum value) after an interrupt error
   1 — Analog output level will remain unchanged after an interrupt error
   2 — Analog output level will go to the maximum value after an interrupt error
4) Press **ENTER** and the unit will return to the Special Functions Mode.

4.2 AUTOMATIC OPERTION *(Page 17)*

The UV lamp is turned off once each analysis is complete. Should the time since the initiation of the last cycle be less than the cycle time, the sample valve will open and the *Purge* light will flash while waiting to begin the next analysis (see Section 3.4).

5.2 SELF-DIAGNOSTIC TEST *(Page 21)*

Any errors displayed can be indexed by repeatedly pressing the **TEST** key. After any errors have been presented, all LED segments will illuminate for a display test. If no errors are present, the instrument will immediately enter this mode and no other keystrokes are necessary.

6.2 ERRORS *(Page 29)*

Error #17 is still reported as *"Low Oxidation Rate,"* however this no longer is linked to a TOC limit of less than 0.2 ppb. The lowest valid TOC level detectable by the A-100 SE is 0.05 ppb.

7.2.1 Commands

In addition to modified or expanded explanations for some commands, two new entries (*RU* and *SE*) have been added to the A-100 SE command set.

DATA READ COMMANDS

RK ANALOG OUTPUT SCALING — reads the full-scale analog output value for either the 4-20 mA or the 0-5 VDC configuration.

RS SOFTWARE VERSION NUMBER — reads the current software (controller firmware) revision number (3.14).

RU AVERAGE TOC — reads the exponentially weighted running average of TOCs over the same time period as for trend analysis. This command is used internally for setting trend stability limits.

RV TREND VALUE — reads the current TOC trend value in ppb/hour (see Section 3.4). The Trend Value is zero until after the second reading after power-up or reset. Otherwise, it is the actual value.

DATA SET COMMANDS

SC CYCLE TIME — the desired cycle time in minutes (negative values are set to zero). When in Manual Mode (see *MM*), a zero value inhibits opening of the purge/fill valve between the termination of an analysis and the next *MO*, *MC* or *MG* command. Non-zero cycle times cause the valve to open and the *Purge* light to flash until a new analysis, cleaning or purge is initiated.

SD FULL-SCALE ANALOG OUTPUT — sets the TOC level, in ppb, which will correspond to a full-scale analog output (see Section 3.7.2).

SE ANALOG TYPE ON ERROR — defines behavior of the analog output during the periods between an interrupt error and the next valid analysis (see Sections 6.2 and 3.7.2). Valid states are:
0 – Analog output level will go to the minimum value (4 mA or 0 VDC)
1 – Analog output level will remain unchanged
2 – Analog output level will go to the maximum value (20 mA or 5 VDC)

SO TOC — sets the TOC value in ppb (alters the calibration factor). A negative value will return the calibration factor to 1.00. Values set before there is a valid TOC (non-zero) reading will be ignored.

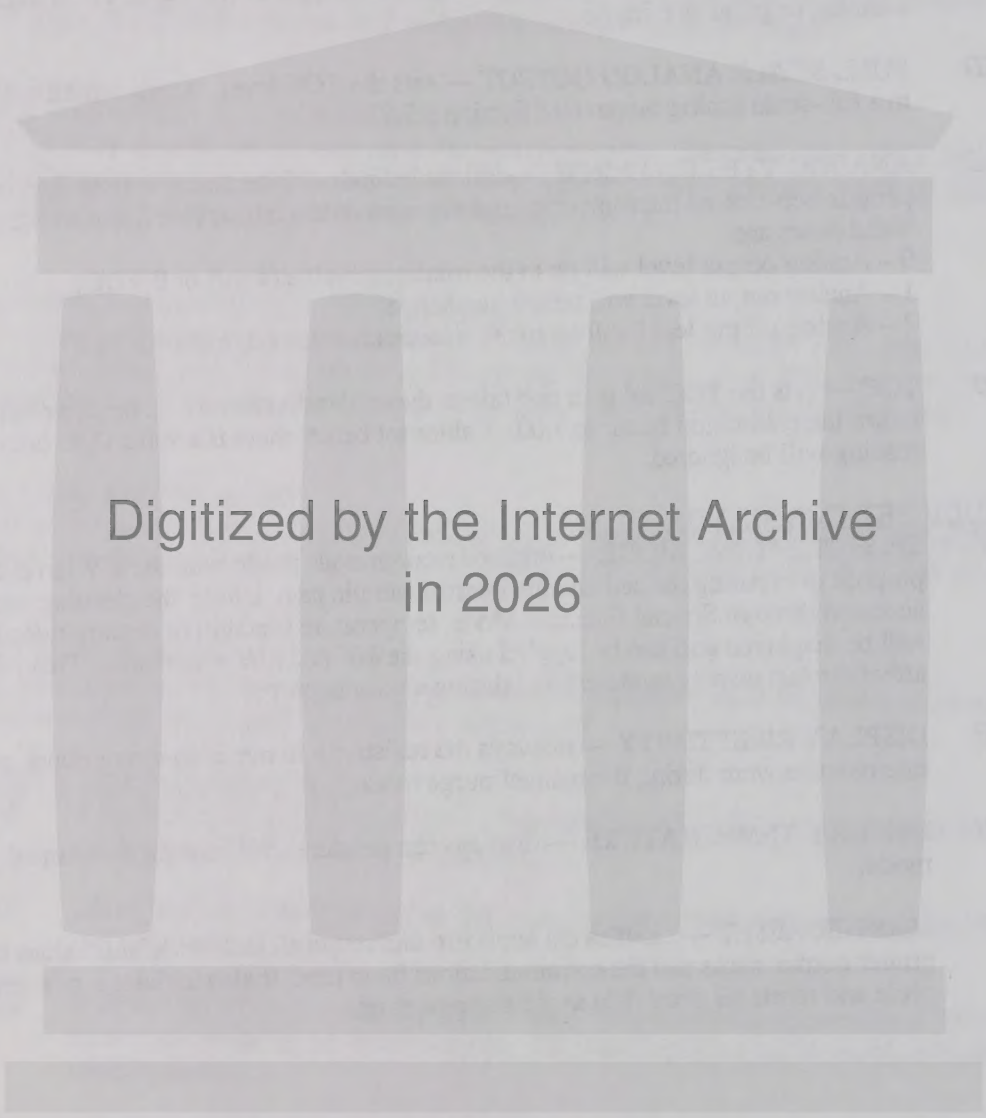
MODE SET COMMANDS

MC SELF-CLEANING MODE — initiates a continuous purge with the UV lamp on for the purpose of cleaning the cell and the internal sample path. Unlike the cleaning process accessed through Special Function Mode, temperature (default) or resistivity/conductivity will be displayed and can be toggled using the *MF* and *MH* commands. This will not affect the last display mode entered during a normal purge.

MF DISPLAY RESISTIVITY — displays the resistivity in megohm-cm or conductivity in microsiemens/cm during the manual purge mode.

MH DISPLAY TEMPERATURE — displays temperature in °C during the manual purge mode.

MR MASTER RESET — enables the keyboard and resets all factory default values except the printer output status and the communications baud rate. It also initiates a new analysis cycle and resets all trend data as if from power-up.



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ANATEL A-100 ORGANICS ANALYZER
VERSION 3.12 SOFTWARE UPDATE

March, 1989

This update to the Anatel Corporation *A-100 Organics Analyzer User Guide* (P/N FG 57000-04) documents changes which were incorporated in Version 3.12 of the unit's software. These changes include additional special parameter functions, a new printout format and an enhanced computer interface capability.

The affected section and page number are given where applicable and appropriate notes should be made in the *User Guide*. The Special Function Parameters described are in addition to those already documented in Section 3.7. Due to the comprehensive changes to the computer interface, "Section 7.0: Output Connector," has been completely revised.

3.7.4 ID DISPLAY

The identification displays accessed through this function include the software revision number and the instrument serial number as well as an output verification test. These items are displayed as follows:

1) Turn the A-100 Analyzer "Off," depress and hold the Dual "Up" Arrow key and turn the unit back "On." The bottom row of function LEDs will illuminate to indicate the Special Function Parameters have been accessed.
2) Press the "Up" arrow key and the software revision number (3.12) will be displayed.
3) Press the "Up" arrow once again and the instrument's serial number will be displayed.
4) Pressing the CLEAR key will exit the current display and return to the Special Function Parameters mode.

Once the software revision number has been displayed, depressing either of the "Down" Arrow keys will initiate the Test Output mode. The entire display will be illuminated to verify all LEDs are operational, the printer will generate a spiral output to verify its character set and the analog output will cycle from 0-20 mA, or 0-5 VDC, as defined in Section 3.7.2.

3.7.5 RESISTIVITY / CONDUCTIVITY DISPLAY

The normal A-100 operational display is resistivity in megohm-cm. Conductivity can now also be displayed in microsiemens/cm. To alter the display:

1) Turn the A-100 Analyzer "Off," depress and hold the Dual "Up" Arrow key and turn the unit back "On." The bottom row of function LEDs will illuminate to indicate the Special Function Parameters have been accessed.

2) Press the TEST key once. In the default mode, the theoretical resisitivity of pure water (18.3) is displayed; in the conductivity mode, the equivalent conductivity (.0548) will be displayed. These modes can be toggled by pressing any of the arrow keys.
3) Press the ENTER key to deposit the desired mode display into the A-100 memory and exit this Special Function Parameter. Pressing either the TEST or CLEAR key without entering a mode change will retain the resistivity default display.

4.4 OPTIONAL PRINTOUT *(Page 18)*

In addition to identifying "Anatel Corporation," a new printout heading also includes the A-100 instrument name and its serial number. This information, like the parameter data and the rest of the report heading, is printed once daily after the previous day's printout is complete and upon each instrument initialization. The current printout heading is:

ANATEL CORPORATION
A-100 Organics Analyzer
S/N XXXX

NOTE: The "UV Lamp Percentage" parameter heading has been removed from the printout and should therefore be ignored in Table 2.

5.3 ULTRAVIOLET LAMP *(Page 21)*

The A-100 now indicates when to replace the UV Lamp and will print the following message at the end of each day:

URGENT: U.V. LAMP NEEDS REPLACEMENT
CONSULT YOUR MANUAL OR CALL THE
ANATEL SERVICE DEPT. @ 303-442-5533

The appearance of this message indicates the UV Lamp should be replaced promptly using the Lamp Replacement Kit (Anatel P/N FG 60000) in order to assure the continued accuracy of the A-100's TOC analyses.

5.4 SOLENOID VALVE *(Page 22)*

Due to the incorporation of a new type of valve, the procedure for cleaning it has changed slightly. Removing and reassembling the valve now requires the use of a Skinner Valve wrench (see Figure 8A) and can no longer be done by hand. Make sure the valve is tight against its base to prevent leaks from occurring once the assembly has been cleaned.

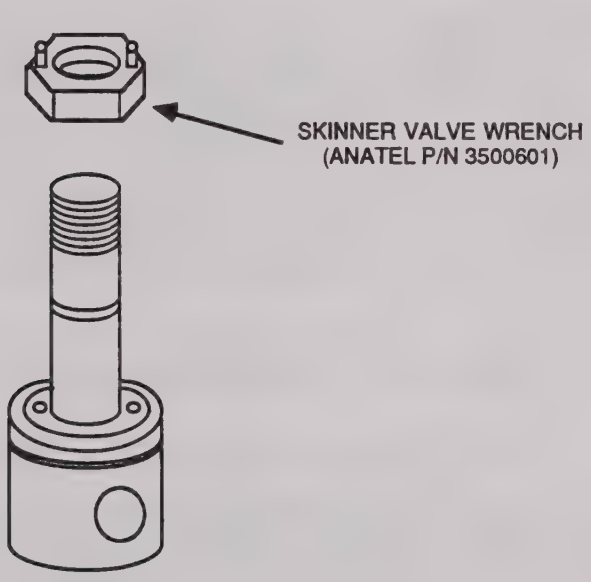

FIGURE 8A: Plunger Housing Assembly

6.2 ERRORS *(Page 31)*

Error #17 is now reported as "LOW OXIDATION RATE" and the limit at which it is triggered has been increased to .2 ppb. Such errors can be caused by a leaking valve, a bad UV Lamp or a lack of flow through the sample line.

7.0 OUTPUT CONNECTOR

7.1 OUTPUT CONFIGURATION

The A-100 Analyzer is equipped with an RS-232 interface which allows the user complete remote programming and reporting capabilities through a host computer. Communications between the A-100 and another device are via a standard RS-232C serial port with an adjustable baud rate ranging from 300 to 9600 baud (see Section 3.7.3). The DB-25 output connector pin assignments are:

PIN	*ASSIGNMENT*
1	EG, Equipment Ground
2	TXD, Transmit Data (From A-100 Controller)
3	RXD, Receive Data (To A-100 Controller)
6	DSR, Data Set Ready (To A-100 Controller)
7	SG, Signal Ground
9	Analog (+)
10	Analog (-)
11	Relay (NO)
12	Relay (Common)
13	Relay (NC)
18	Ground
20	DTR, Data Terminal Ready (From A-100 Controller)

External Printer — A-100 transmits data on Pin 2, DSR is on Pin 6 and Pin 7 is Ground.

Computer Interface — A-100 receives data on Pin 3 and transmits data on Pin 2; DSR is on Pin 6 and DTR is on Pin 20; Pin 7 is Ground. A three-wire XON/XOFF configuration requires only TXD, RXD and GND connections.

Analog and *Relay Outputs* are determined with the A-100 unit in a power "ON" state. The maximum load resistance for a current output is 350 ohms; minimum resistance for a voltage output is 500 ohms.

Alarm Contact Output can be set to "Normally Open" or "Normally Closed." The Maximum load rating for the relay contacts is 1 Amp at 24 VDC.

7.2 COMPUTER INTERFACE

The communications protocol for the A-100 Analyzer is configured to respond to both Xon/Xoff and reverse channel (DTR) signals, allowing operation with a computer using either format. Since all commands are only a few bytes long (depending upon the value sent) and the buffer in the controller will hold over 100 bytes, the data should never be sent too fast to be processed. Baud rate, parity, data and stop bits are the same as those specified in Section 3.7.3 and all values sent and received are in an ASCII format. For example, 1,250 would be:

Byte1	*Byte2*	*Byte3*	*Byte4*	*Byte5*	*Byte6*	*Byte7*	*Byte8*
1	.	2	5	e	3	<cr>	<lf>

Or, optionally:

1 2 5 0 <cr> <lf>

ASCII numbers are sent as they would be entered into a calculator including decimal points, exponential factors and negative values. For example, -1.23 may be entered as -1.23 or -123e-2. Spaces and line feeds are ignored.

7.2.1 Commands

Commands consist of Data Set, Mode Set and Data Read functions and do not interface with operations code, with the exception of Mode Set commands which initiate or change analyses. They are sent to the A-100 as simple 2-letter ASCII mnemonics. A carriage return (<cr>) is used to indicate the end of the command. An optional line feed (<lf>) may be added if desired before or after the <cr>. In all cases, Data Read commands received by the A-100 unit will initiate a reply consisting of one or more streams of ASCII-formatted data (no exponentials), each followed by a <cr><lf>. Data Set commands require additional data (sent as detailed in Section 7.2 above) and, like most Mode Set commands, give no response.

NOTE: The A-100 will respond to upper- or lowercase commands, although it is good practice to use only capital letters.

DATA SET FUNCTIONS

Issuance of these setup commands must be followed by a <cr>, the ASCII code representing the value to be input and another <cr>. The A-100 will suspend operation until the input value is received. If an "out-of-bounds" value is used, the factory default value will be substituted, if applicable. All Data Set functions require only one value with the exception of "SY," the date and time. In this case, each value must be followed with a <cr>.

COMMAND	*FUNCTION*
SC	CYCLE TIME – Set desired cycle interval in minutes.
SD	FULL-SCALE ANALOG OUTPUT – Set desired full-scale analog output value in ppb.
SF	CALIBRATION FACTOR – Set desired calibration scaling factor.
SL	ALARM LIMIT – Set desired alarm limit in ppb.
SO	TOC – Set the TOC value in ppb (alters calibration factor).
ST	TREND TIME – Set desired trend interval in minutes.
SU	PURGE TIME – Set desired purge time in minutes.
SY	DATE AND TIME – Set as six values representing year, month, day, hour, minute and second (24-hour clock).

MODE SET FUNCTIONS

These functions are used to set operating modes in the A-100 Analyzer or to control the printer or analog output.

COMMAND	*FUNCTION*
MB	ENABLE KEYBOARD – Enables all keyboard functions.
MC	SELF-CLEANING MODE – Initiates a continuous purge (valve open and UV lamp on); the resistivity/temperature display, unlike the Manual Mode, is active and can be toggled using "MF" and "MH" commands.
MD	AUTOMATIC MODE – Initiates normal measurement run cycle.
ME	CLEAR ERRORS – Clears the entire error stack.
MF	DISPLAY RESISTIVITY – Reports resistivity value in megohm-cm or conductivity in microsiemens/cm during the manual purge mode.
MG	PURGE MODE – Initiates manual purge mode (valve open, UV light off); resistivity/temperature display can be toggled using "MF" and "MH" commands, respectively.
MH	DISPLAY TEMPERATURE – Reports temperature in °C during purge mode.
MK	DISABLE KEYBOARD – Disables all keyboard functions until the "MB" command is sent or the A-100 is manually turned "Off" and back "On."
ML	DISABLE PRINTER OUTPUT – Disables internal printer until an "MP" command is received (survives power cycling).
MM	MANUAL MODE – Prevents initialization of a new measurement run until an "MO" command is received, allowing the unit to be controlled externally.
MO	START TOC ANALYSIS – Restarts measurement run at fill cycle; also exits purge or self-cleaning mode.
MP	ENABLE PRINTER – Enables printer output.
MR	MASTER RESET – Enables keyboard and resets all factory default values except printer output status.
MT	TEST MODE – Used primarily for diagnostics, initiates check of all memory and math functions, reports the error stack as a variable-length list accumulated since the last "ME" or "MT" command (or manual test) terminated by a "0" and then clears the error stack. If no errors are present, "0" is sent.

DATA READ FUNCTIONS

All data read command functions return one value except the Error Stack ("RE"), Run Start Time ("RG"), Time and Date ("RY") and Run Parameter ("RZ") functions. With these variable length commands, each data value is terminated with a <cr><lf>.

COMMAND	*FUNCTION*
RA	ALARM LIMIT – Reads last TOC value as percentage of the alarm limit.
RB	PROFILE TYPE – Reads profile type of last completed run: 1 = Easy to Oxidize 2 = Moderately Difficult to Oxidize 3 = Difficult to Oxidize
RC	CYCLE TIME – Reads set cycle time in minutes.
RD	TEMPERATURE – Reads temperature in °C at initiation of measurement run or continuously during purge cycle.
RE	ERROR STACK – Reads the codes of up to 5 detected errors as a variable-length list accumulated since the last "ME" or "MT" command (or manual test) terminated by a "0." If no errors are logged, "0" is sent.
RF	CALIBRATION FACTOR – Reads the set scaling factor used to correct TOC values.
RG	RUN START TIME – Reads start time of the current TOC run (not necessarily the last completed run) in hours, minutes and seconds.
RH	ELAPSED TIME – Reads the oxidation time of the last completed TOC run in seconds.
RI	COMPLETED RUNS – Reads the number of runs completed since the last "RI" inquiry (reports "-1" if fatal errors were encountered on the last analysis) and then resets to "0."
RK	ANALOG OUTPUT SCALING – Reads the value set for full-scale analog output (4-20 mA or 0-5 VDC).
RL	ALARM LIMIT – Reads the set alarm limit in ppb.
RM	ANALOG OUTPUT MODE – Reads set analog output ("4" = 4-20 mA, "5" = 0-5 VDC). ***NOTE:*** *A-100 internal jumpers must be properly set.*
RN	SERIAL NUMBER – Reads the A-100 serial number.
RO	TOC – Reads TOC value in ppb of last completed run.
RP	PURGE TIME – Reads set time of purge cycle in minutes.
RQ	ALTER PARAMETERS FLAG – Reads the parameter change flag (reports "1" when any parameter is altered from the keypad and is reset to "0" when read).
RR	RESISTIVITY – Reads resistivity in megohm-cm (regardless of the display mode) at the initiation of a measurement run or continuously during purge cycle; conductivity in micromho/cm may be calculated as the inverse value (1/resistivity).

"DATA READ" FUNCTIONS

COMMAND	*FUNCTION*
RS	SOFTWARE VERSION NUMBER – Reads current software revision number (3.12).
RT	TREND TIME – Reads set time of trend measurement in min.
RV	TREND VALUE – Reads current TOC trend value in ppb/hour (responds with "0" until a full trend period expires).
RX	SYSTEM STATE – Reads current state of measurement run: 0 = Initialization or no internal communications 1 = Fill Cycle 5 = Purge Mode 2 = Oxidize Cycle 6 = Test Mode 3 = Measure Cycle 7 = Calibration Mode 4 = Extended Purge Cycle 8 = Self-Cleaning Mode
RY	TIME AND DATE – Reads internal clock time and date as six values: year, month, day, hour, minute and second (24-hour clock).
RZ	RUN PARAMETERS – Reads the last completed measurement run. as eight values: run start time in hours, minutes and seconds, elapsed oxidation time in seconds, TOC in ppb, temperature in °C, resistivity in megohm-cm and profile type (1, 2, or 3), respectively. This command will ensure that the reported values are all from the same run.

7.2.2 Operation

If the program written to interface the A-100 Analyzer is not fast enough to keep up with the data being returned, it is recommended the Xon/Xoff protocol be used by following each command with a Xoff character so that the A-100 response will not be sent until an Xon character is received. The program should be structured such that the A-100 response time (.5 to 3 seconds) is not critical. If interface problems arise, it is suggested that a properly configured terminal be directly connected to the computer interface port. With a half-duplex terminal, both the commands and the responses will be clearly displayed on the screen, allowing the user to become familiar with the software.

Initially, any desired setup commands should be issued to define the A-100 operational parameters. Since the printer and computer use the same output port, the printer must be turned off using the "ML" command. This way, the only characters from the port will be responses to the commands issued from the computer. It is also recommended the Software Revision Number ("RS") and the A-100 Serial Number ("RN") be read to confirm communications. If the A-100 Controller keyboard is enabled, the "RQ" command should be issued at least once per analysis cycle in order to keep the parameter data current.

NOTE: *The A-100 Analyzer automatically installs the factory default values. No additional setup is required unless parameters must be changed.*

Two commands ("MO" and "MR") will initialize analysis by the A-100. The "MO" command will interrupt current operation and initiate a TOC run; "MR" executes a Master Reset, restoring all factory default values and therefore should not be used to initiate an analysis cycle. The Manual Mode is provided to allow A-100 operation to be controlled by a data acquisition timetable or some other external driving device. The "MO," "MG" and "MC" commands then initiate their respective operations, although each analysis cycle must still be initiated with an "MO" command. A period of at least 3 seconds should elapse before any new enquiries are made when any of the commands that change analysis modes ("MC," "MG," "MO" or "MR") are sent in order to allow the instrument to consolidate run parameters.

Several commands allow the real-time parameters to be read including "RD" (Temperature), "RR" (Resistivity), "RO" (TOC Value), "RB" (Run Profile Type), "RG" (Run Start Time) and "RH" (Run Elapsed Time). Each of these commands returns the most current value. Since some values are read at the beginning of the run and some at the end, care must be exercised in issuing these commands. For example, if the A-100 is polled every minute and a TOC value is received, the unit may already be on its next run. The previous values are still retained, so the report is mixing data from two runs and, consequently, is not accurate.

The "RZ" command avoids this eventuality by returning only values from a single run. "RZ" will provide the data from the most recent completed run. The block of returned data will contain the run start time, elapsed time, TOC, temperature and resistivity values and the profile type, respectively. The run start time is returned in hours, minutes and seconds, followed by the remaining five values. All eight datum are terminated with <cr><lf>.

Since the run length varies, the unit must occasionally be polled for the end of the run. The recommended polling time is once every 10 seconds because the A-100 must momentarily halt the TOC measurement cycle each time it receives a command. If polled continually, the command will interfere with operation, extending the time required for analysis. If polled too infrequently, the results may not reflect meaningful readings, although this condition will only occur if the poll time is longer than the run time. Typical run times range from 3 to 15 minutes depending upon the type of organic present.

"RI" will access a flag which reports on the run status. The response will be "-1," "0" or a positive integer. A "0" indicates the run is still in progress and no errors have been detected. A "1" indicates one run has been completed, a "2" two runs, and so on. This provides and indication of how long it has been since the last readings were taken. After responding to the "RI" command, the run status flag will automatically be reset. A "-1" response to the run status inquiry indicates an error condition is present. An or "RE" (or "MT") command will access the error codes. Up to 5 error codes will be sent, each terminated by a <cr><lf> sequence. The last response sent will be a "0," followed by a <cr><lf>. These errors are cleared automatically as part of the "MT" command sequence, or may be cleared manually by issuing an "ME" command.

TABLE 5 — INTERFACE COMMANDS

COMMAND	"DATA SET" FUNCTION
SC	Cycle Time
SD	Full-Scale Analog Output
SF	Calibration Factor
SL	Alarm Limit
SO	TOC Value
ST	Trend Time
SU	Purge Time
SY	Date and Time

COMMAND	"MODE SET" FUNCTIONS
MB	Enable Keyboard
MC	Self-Cleaning Mode
MD	Automatic Mode
ME	Clear Errors
MF	Display Resistivity
MG	Purge Mode
MH	Display Temperature
MK	Disable Keyboard
ML	Disable Printer Output
MM	Manual Mode
MO	Start TOC Analysis
MP	Enable Printer Output
MR	Master Reset
MT	Test Mode

COMMAND	"DATA READ" FUNCTION
RA	Alarm Limit
RB	Profile Type
RC	Cycle Time
RD	Temperature
RE	Error Stack
RF	Calibration Factor
RG	Run Start Time
RH	Elapsed Time
RI	Completed Runs
RK	Analog Output Scaling
RL	Alarm Limit
RM	Analog Output Mode (4-20 mA / 0-5 VDC)
RN	Serial Number
RO	TOC Value
RP	Purge Time
RQ	Altered Parameters
RR	Resistivity
RS	Software Version
RT	Trend Time
RV	Trend Value
RX	System State
RY	Time and Date
RZ	Run Parameters

ANATEL
POWER SUPPLY CONNECTIONS

A100

TERMINAL #	COLOR	SIGNAL
1	BROWN	26 Vdc (F1– bottom) 3A
2	RED	+23 Vdc (F4 – top) 3A
3	ORANGE	-23 Vdc (F2) 3A
4	YELLOW	+11 Vdc (F3) 3A
5	GREEN	GROUND
6	BLUE	SIG. GROUND
7	PURPLE	COMMUNICATIONS
8	GRAY	COMMUNICATIONS

A100PSE

TERMINAL #	COLOR	SIGNAL
1	BROWN	+24 Vdc (0.6 A)
2	RED	+12 Vdc (1.3 A)
3	ORANGE	-12 Vdc (0.1 A)
4	YELLOW	+ 5 Vdc (1.0 A)
5	GREEN	COMMON

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1.0 GENERAL DESCRIPTION

1.1 INTRODUCTION

This guide furnishes user information on the Anatel Instrument Corporation A-100 Organics Analyzer. In addition to installation and operation instructions, complete programming and maintenance procedures are also documented.

It is recommended that this guide be read thoroughly in order to familiarize the user with the A-100 Analyzer and its operation. Throughout the manual, the words NOTE and CAUTION will be found. A NOTE will provide additional information; a CAUTION is a warning statement which, if ignored, could result in damage to the Analyzer or its associated equipment.

1.2 THE ANATEL A-100 ORGANIC CARBON ANALYZER

The Anatel A-100 Organics Analyzer is an online instrument which automatically and continuously measures the Total Organic Carbon (TOC) level in pure water. Typical process applications include organic contamination detection in semiconductor manufacturing and power generating plants, as well as various biochemical and laboratory analysis applications. Using a microprocessor-controlled photoionization process with conductivity detection, the A-100 is capable of detecting TOC levels between 1 and 10,000 parts per billion (ppb), its greatest accuracy being in the range of 10 to 1000 ppb.

A downstream valve closure isolates a pure water sample in the unit's Sensor Compartment. Subsequent irradiation with intense ultra-violet (UV) light then breaks down the organic compounds in the water. The freed carbon creates carbon dioxide (in solution) in the form of carbonic acid. The TOC concentration is determined, and displayed, by calculating the change in conductivity of the sample. The available water system pressure is then employed to rinse the line and the test chamber prior to the next sample analysis.

The results of each sample analysis are digitally displayed on the Controller panel of the A-100 Analyzer as a concentration of TOC in ppb. Additionally, resistivity (in Megohm-cm, corrected to 25°C) and sample temperature (in °C) are measured and can be displayed upon request. The A-100 also performs trend analyses to allow water quality management. The unit automatically measures the change in TOC values over a programmable time interval and reports, via an "Up" or "Down" arrow indicator, the overall trend of the TOC level. By further examining the exact TOC values on an optional printout, the operator can instantly determine if the trend is significant and take appropriate corrective action.

The A-100 Organics Analyzer is easy to install and can quickly be functional for troubleshooting, field evaluation or verifying the calibration of other analysis equipment. Its dynamic, closed system not only allows parallel sampling, but also minimizes the potential for erroneous data. Specified at the time it is ordered, the A-100 can operate on a standard 115 VAC or a 230 VAC supply. All of the unit's parameters are user-programmble, allowing its operation to be customized to the requirements of the particular analysis application.

1.3 A-100 ORGANICS ANALYZER FEATURES

The A-100 Organic Carbon Analyzer (see Figure 1) is comprised of an ultraviolet Sensor Compartment, a Power Supply unit and a Controller which houses both the visual display and a keypad for entering operational parameters. The A-100 also contains the support circuitry, as well as the necessary sample tubing, to provide a complete online pure water analysis laboratory.

In addition to the TOC reports, other Controller displays include the trend indicator and operational mode LEDs which provide the user with a quick visual report on the status of the unit. A bargraph consisting of four green LEDs reports on the percent (in 25% increments) of the selected TOC alarm limit; a red Alarm LED indicates when the limit has been exceeded.

Equipped with an optional Interface Board, the A-100 Organics Analyzer is capable of such additional features as a 4-20 mA (or 0-5 VDC) analog output, an alarm contact relay output and an RS-232 interface for external report and host computer functions. Other optional equipment includes a 40-column thermal printer and an analog chart recorder, both of which provide a hard copy of important analysis data.

FIGURE 1 — THE ANATEL A-100 ORGANIC CARBON ANALYZER

1.4 SPECIFICATIONS

The Anatel A-100 Organics Analyzer is designed for use in applications which monitor pure water with a typical resistivity greater than 5 Megohm-centimeter at 25° Centigrade. Performance of the unit may be affected slightly at lower resistivity levels, depending upon the the conducting species. The A-100 is most accurate within a Total Organic Carbon (TOC) range of 10 to 1000 ppb, although the unit is capable of indicating approximate TOC levels in the ranges of 1 to 10 and 1000 to 9999 ppb.

NOTE: Specifications are subject to change without notice.

1.4.1 Environmental Characteristics

Power Requirements	
Standard:	110 VAC ± 20%, 50/60 Hz
Optional:	230 VAC ± 10%, 50/60 Hz
Operating Temperature:	41°F to 122°F (5°C to 50°C)
Sample Water	
Temperature:	59°F to 104°F (15°C to 40°C)
Pressure	
Standard:	4 to 100 psi (0.3 to 7.0 kg/sq cm)
Low Range (Optional):	0.5 to 15 psi (0.04 to 1.0 kg/sq cm)

1.4.2 Performance Characteristics

Dynamic Measurement Range:	10 ppb to 1000 ppb
Total Measurement Range:	1 ppb to 9999 ppb
	(Approximates value from 1 - 10 and 1000 - 9999 ppb)
Repeatability:	±1 ppb at 10 ppb
	±2% of measured value at 200 ppb
Resolution:	
Less than 200 ppb:	0.1 ppb
Greater than 200 ppb:	1.0 ppb
Typical Analysis Time:	3 - 5 minutes
Resistivity Range (at 25°C)	
Standard:	0.1 to 18.3 Megohm-cm Resistivity
Optional:	10.0 to 0.0546 Micromhos/cm Conductivity
Compensation:	25°C
Accuracy:	±1.5%
Controller:	Microprocessor-based

1.4.3 Physical Characteristics

Sensor Compartment:	Industrial-grade NEMA 13 Enclosure
Size:	10" H x 8" W x 4" D
	(254 mm H x 203 mm W x 101 mm D)
Weight:	11 lbs (5 kg)
Controller:	Splash-proof, Panel-Mount Enclosure
Size:	2.75" H x 4.75" W x 7" D
	(70 mm H x 120 mm W x 178 mm D)
Weight:	3 lbs (1.4 kg)
Power Supply:	Industrial-grade NEMA 13 Enclosure
Size:	8" H x 6" W x 3.5" D
	(203 mm H x 152 mm W x 89 mm D)
Weight:	10 lbs (4.5 kg)

Sensor: Wetted parts made of fused silica, non-porous ceramic, 316 stainless steel, titanium and non-leaching fluoropolymers.

Sample Tubing	
Inlet (5-foot):	1/4" PFA, 1/4" NPTM Fitting
Outlet (10-foot):	Bevaline 1/4" Plastic
Optional Outputs:	4-20 mA or 0-5 VDC Analog Output Signal
	RS-232C Serial Computer Interface
	NO or NC Alarm Contact Closure
	Printer Output

1.4.4 Optional Printer Specifications

Power Requirements (specified when ordered):	115 or 230 VAC, 50/60 Hz
Printing Speed:	24 cps
Print Format:	5 X 7 Dot Matrix
Paper Size:	3.12"
Printer Size:	2.7" H x 4.5 " W x 5.7" D
	(68 mm H 114 mm W x 145 mm D)
Front Panel:	3.1" H x 5.25" W
	(79 mm H x 133 mm W)
Printer Weight:	2.25 lbs (1 kg)

1.4.5 Optional Chart Recorder Specifications

Power Requirements (specified when ordered):	115 or 230 VAC, 50/60 Hz
Accuracy:	±2%
Maximum Response Time:	1 Second
Standard Chart Speed:	1" per Hour
Usable Chart Width:	2-5/16"
Usable Chart Length:	63 feet
Recorder Dimensions:	5-5/8" H x 3-5/8" W x 4-5/16" D
	(143 mm H x 92 mm W x 110 mm D)
Recorder Weight:	3.75 lbs (1.7 kg)

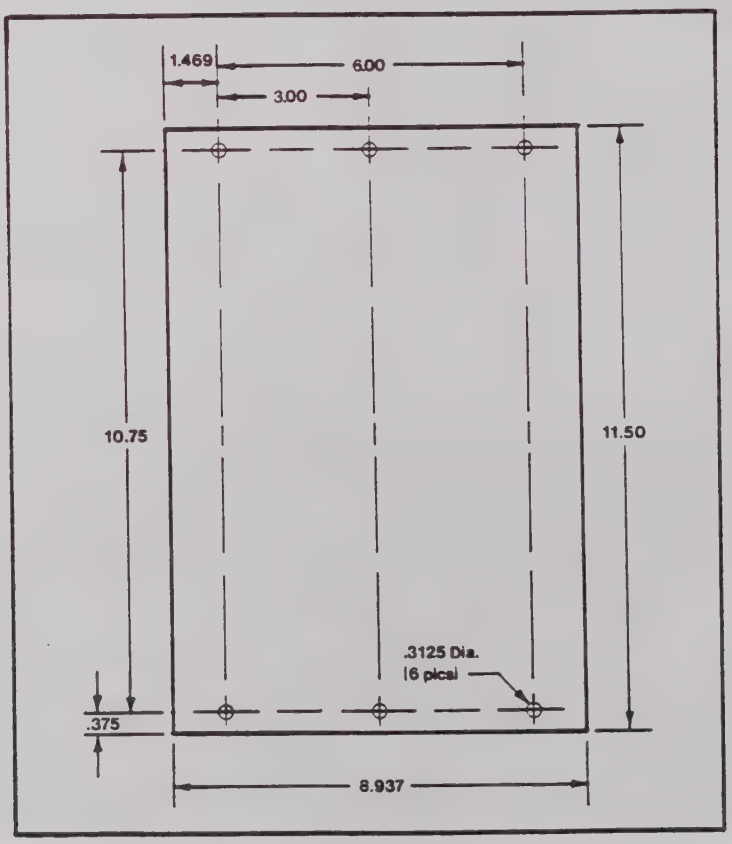


FIGURE 2 — SENSOR COMPARTMENT MOUNTING

2.0 INSTALLATION AND START-UP

2.1 INSPECTION

Inspect the shipping container for any signs of external damage before unpacking the A-100. If any damage is apparent, notify the carrier immediately: any freight claims must be filed by the customer. Unpack the equipment, verify the packing list and check once again for any obvious damage. Notify Anatel Instrument Corporation or your distributor if there are any problems. Include the serial number of the unit and your purchase order number with any correspondence.

2.2 INSTALLING THE A-100 ORGANICS ANALYZER

Installation of the Anatel A-100 Organics Analyzer is an easy process consisting of mounting each of the unit's components and providing the necessary tubing and power connections. When selecting a location for the A-100, consider such factors as cabling and tubing restrictions as well as accessiblity to the components and their wiring. The A-100 components should be mounted on studs or beams which can adequately support their weight.

CAUTION: DO NOT MOUNT THE A-100 IN LOCATIONS WHERE WATER MAY FREEZE INSIDE THE UNIT OR THE FLOW PRESSURE EXCEEDS 100 PSIG

2.2.1 Sensor Compartment Mounting

The Sensor Compartment must be mounted vertically so that the sample water will flow through the unit properly. Allow a minimum of 6" of clearance at the top and bottom of the compartment for the inlet and outlet tubing. Secure the compartment using the holes provided in the top and bottom brackets. Mounting dimensions are shown in Figure 2.

In its standard configuration the unit can accept input water pressure in the range of 4 to 100 psig (0.3 to 7 kg/sq cm). An optional low pressure version is available without a flow restrictor which accepts water pressure ranging from 0.5 to 15 psig (0.04 to 1.0 kg/sq cm). The A-100 should be connected to the sample supply through an upstream (user-supplied) isolation valve, or other suitable port, to allow control of the input flow. To avoid the possibility of foreign matter being introduced into the unit through the inlet plumbing, flush the isolation sample valve thoroughly before connecting the sample tubing by opening and closing the valve <u>fully</u> several times.

Once the Sensor Compartment is securely mounted and the sample supply flushed, make the following tubing connections:

1) Locate the stainless steel 1/4" tube fitting provided and wrap the 1/4" MNPT end with 3 or 4 wraps of teflon thread tape.
2) Install the fitting into the isolation valve using a 5/8" wrench and then loosen the compression nut 1/2 turn.
3) Locate the 5-foot length of sample tubing, insert one end into the rear of the compression nut and push it in as far as it will go. Be careful not to crimp or damage the tubing.
4) Tighten the compression nut <u>hand-tight</u> and then mark both it and the fitting body at the 9 o'clock position.
5) While holding the fitting body with a 5/8" wrench, tighten the 9/16" nut 1-1/4 turns beyond the marks to secure the fitting.

CAUTION: DO NOT OVERTIGHTEN THE FITTING OR THE COMPRESSION FERRULES WILL BE CRUSHED AND THE CONNECTION WILL LEAK

6) Similarly attach the other end of the sample tubing to the WATER IN port. Hold the fitting body surface on the outside of the Sensor Compartment while tightening the compression nut.
7) Locate the 10-foot drain tubing and install one end to the WATER OUT port. Hold the surface of this fitting on the inside of the Sensor Compartment while tightening the compression nut. Run the other end into a suitable drain.
8) Leak test the connections by opening the isolation valve to introduce water into the sensor. Pulse the valve several times by opening and closing it and then recheck the fittings. Carefully tighten the fittings as necessary to stop any leaks.

2.2.2 Controller Mounting

The Controller is a panel mount unit which provides the user interface with the A-100 system. To install the Controller:

1) Cut an opening in the desired mounting panel according to the dimensions shown in Figure 3.
2) Drill the four 5/32" mounting holes as indicated.
3) Locate the adhesive faceplate gasket supplied. Peel the backing off, insert the gasket over the body of the Controller and stick it to the rear of the faceplate. The gasket will help to protect the Controller and seal it against moisture.

CAUTION: ONLY THE CONTROLLER FACEPLATE IS WATER-RESISTANT — DAMAGE TO INTERNAL COMPONENTS MAY OCCUR IF MOISTURE IS ALLOWED TO REACH THE REAR OF THE CONTROLLER

4) Mount the Controller into the panel using the four 6-32 x 1/4" seal screws provided. The clearance between the cutout and the body of the Controller is .050.

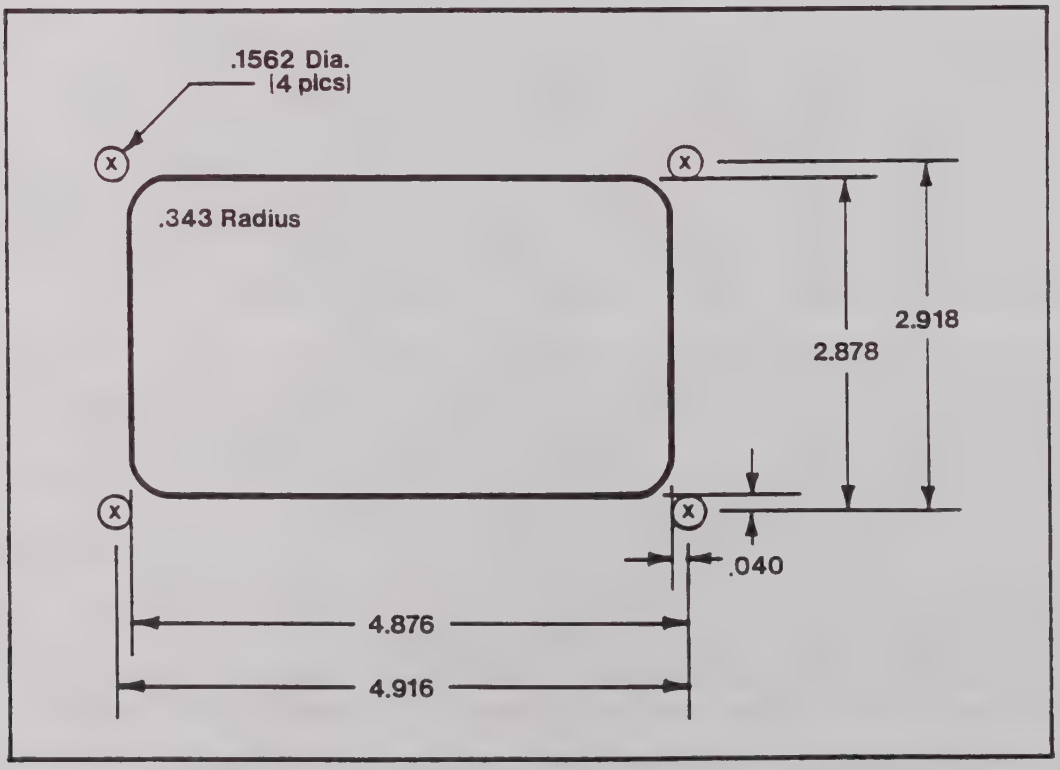


FIGURE 3 — CONTROLLER MOUNTING

2.2.3 Power Supply Mounting

The Power Supply can be mounted in any convenient orientation using its two brackets according to the dimensions shown in Figure 4. Allow at least 2" of clearance at the bottom of the Power Supply so that the Sensor, Controller and Power cables are not crimped.

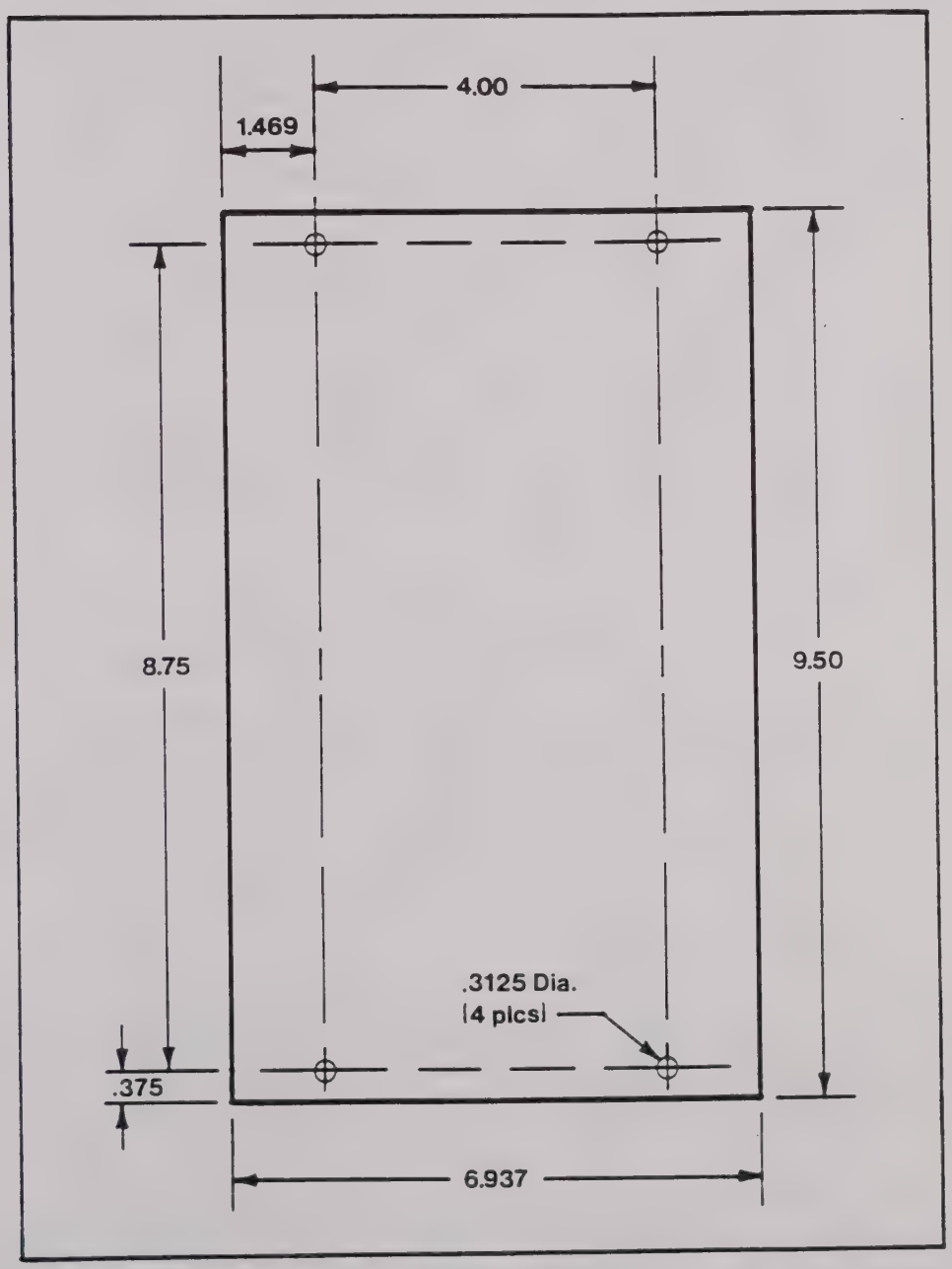


FIGURE 4 — POWER SUPPLY COMPARTMENT MOUNTING

2.3 WIRING THE A-100 ORGANICS ANALYZER

Once the A-100 components have been securely mounted, the system's wiring connections must be established. The Power Supply unit is prewired for 115 (or 230) VAC, while interface cabling is furnished to provide connections to the Sensor Compartment and the Controller. Interface cables are also supplied to connect the optional printer or analog chart recorder. The necessary cabling must be supplied by the user, however, to incorporate the RS-232 interface for external output or host computer functions.

2.3.1 Sensor Compartment Connections

Sensor Compartment wiring connections are made using the 8-wire cable from the Power Supply labelled TO SENSOR. To make this connection:

1) Loosen the two clamps and open the Sensor Compartment door.
2) Remove the brown plastic splash shield by gently squeezing its right rear side. The cover will pop from its track and can then be removed to allow access to the compartment's electronics.
3) Locate the TO SENSOR cable exiting the Power Supply. The cable has eight colored wires with the free ends stripped and tinned.
4) Insert the free end of the cable into the Sensor Compartment through the strain relief bushing in the bottom of the enclosure.
5) Wiring connections are made on the 8-position screw-in terminal block located in the bottom left corner of the compartment (see Figure 5). Turn each screw in the block fully counterclockwise.
6) Referring to the chart in Figure 5, connect each wire individually and tighten the screw to secure it. Hold the terminal block to support it while tightening the screws to avoid damaging it. Also make sure the contact is clamped to the wire and not to the insulation.
7) Check the connections by gently pulling on each wire. If the wire pulls out, reconnect and recheck it.

CAUTION: VERIFY THE WIRES ARE CONNECTED TO THE PROPER TERMINALS — IMPROPER WIRING COULD CAUSE SEVERE DAMAGE TO THE A-100 WHEN POWER IS APPLIED TO THE UNIT

8) Insert enough cable into the compartment to prevent tension on the wires and secure it by turning the strain relief bushing hand-tight.
9) Replace the splash shield by first fitting the front left edge into its channel and then squeezing the right rear edge to engage it.
10) Leave the Sensor Compartment door open while the remaining wiring connections are made so that another leak check may be performed at start-up under normal operating conditions.

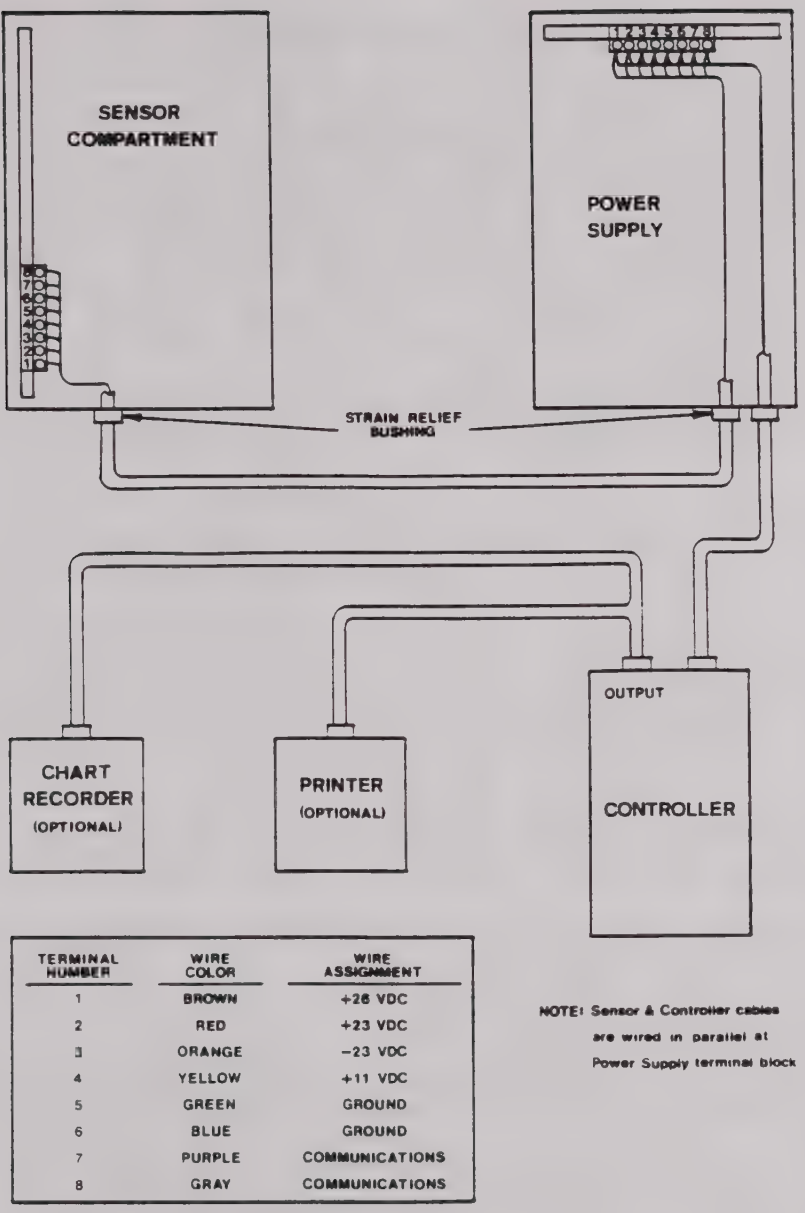
2.3.2 Controller Connections

The Controller is also wired directly to the Power Supply using the 9-pin cable labelled TO CONTROLLER. To make this connection:

1) Locate the prewired 9-pin cable from the Power Supply and, noting the orientation, insert the free end into the connector labelled TO POWER SUPPLY on the rear of the Controller unit.
2) Tighten the screw on each end of the connector to secure it.

2.3.3 Power Supply Connections

Once the Power Supply has been wired to the Sensor Compartment and the Controller, all that remains is to plug it into its power source. The power cord is prewired inside the Power Supply unit and is labelled on the bottom of the compartment as either 115 VAC or 230 VAC. Plug the power cord into an appropriate supply.



TERMINAL NUMBER	WIRE COLOR	WIRE ASSIGNMENT
1	BROWN	+26 VDC
2	RED	+23 VDC
3	ORANGE	-23 VDC
4	YELLOW	+11 VDC
5	GREEN	GROUND
6	BLUE	GROUND
7	PURPLE	COMMUNICATIONS
8	GRAY	COMMUNICATIONS

NOTE: Sensor & Controller cables are wired in parallel at Power Supply terminal block

FIGURE 5 — A-100 ANALYZER WIRING CONNECTIONS

2.3.4 Optional Printer and Chart Recorder

Both of these optional devices are shipped with their own independent power supply cables as well as a 5-foot interface cable. If both the options are incorporated, a single "Y" interface cable is furnished. In either case, connections are made on the rear of the Controller unit. To connect either recording device:

1) Locate the appropriate cable and plug the end of the 25-pin connector labelled CONTROLLER into the OUTPUT connector on the rear of Controller. Tighten the screws at each end of the connector.
2) Plug the other end into the 25-pin connector on the PRINTER or the CHART RECORDER and tighten the two screws to secure it.
3) Plug the accompanying power supply cable (4-pin for the printer and 6-pin for the chart recorder) into the appropriate connector on the rear of the corresponding recording device.
4) Finally, plug the other end of the power supply cable into a standard 115 (or 230) VAC source.

2.4 START-UP

With all components mounted and the wiring connections properly established, the A-100 unit can be started. To initialize the unit:

1) If an isolation valve is used, open it to begin flow to the sensor.
2) If incorporated, turn the power switch to the optional printer "On." The green LED on the printer faceplate will light to indicate that it is receiving power and the print head will travel across the page once before stopping in its "home" position.
3) Turn the A-100 unit "On" by depressing the red power switch on the front of the Power Supply. It will illuminate to indicate the unit is receiving power. If the switch does not illuminate, verify that the Power Supply is plugged in. Also check the 1.0 Amp, 250 VAC fuse on the bottom of the Power Supply. If the fuse is good, contact the factory for assistance.

CAUTION: DO NOT REMOVE THE FUSE OR OPEN THE POWER SUPPLY UNIT WITH THE POWER CORD PLUGGED IN — HIGH VOLTAGE IS PRESENT

The A-100 will initially perform a self-diagnostic routine, indicated by the flashing TEST lamp on the Controller display. These internal diagnostics verify proper operation of the unit each time it is turned on. If the printer is installed, the A-100 will also generate a printout of all current parameters and report headings (see Section 4.4). If a fault condition exists, the ERROR LED will be illuminated. To examine any faults detected during self-diagnostics, push the TEST key when the unit begins an analysis cycle, indicated by illumination of the FILL LED. See Section 6.2 for detailed error information.

NOTE: If the TEST LED flashes and the ERROR LED is illuminated at power-up, it indicates the Controller cannot establish communications with the Sensor Compartment (Error Code "100"). Turn the A-100 "Off," unplug the power cord and recheck the Sensor Compartment and Power Supply for proper wiring and voltage.

When the diagnostic cycle has been successfully completed, the A-100 must be placed in the Self-Cleaning Mode in order to assure a clean sensor cell after prolonged storage. To initiate Self-Cleaning:

4) Turn the Power Supply Switch "Off."
5) While holding down the Dual "Up" Arrow key on the Controller, restore power. Releasing the key will place the A-100 in the Special Functions Mode, indicated by illumination of the bottom row of LEDs.
6) Press the PURGE key to turn the UV lamp on and open the solenoid valve. The corresponding LED will illuminate and water will flow through the unit.
7) Monitor the drain tube to verify sample water flow; it should be a minimum of .1 gallon/minute (.38 liter/minute). Also, with the unit under normal operating conditions, recheck the Sensor Compartment for leaks. Carefully tighten leaking fittings as necessary.
8) Allow the Analyzer to operate in the Self-Cleaning Mode for at least 15 minutes. Allow more time if the sample point is at low pressure, such as a gravity feed tube.
9) When the system has cleaned sufficiently, press the PURGE key once again to exit the Self-Cleaning Mode.
10) Turn the Power Supply Switch "Off" to exit the Special Functions Mode then close and secure the Sensor Compartment door.
11) Turn the A-100 "On" again to initiate an automatic analysis cycle.

NOTE: Results of the first few analysis cycles should be suspect: the UV lamp must reach operating temperature and the lamp chamber properly rinse and clean itself. Therefore, allow two complete analysis cycles before accepting the reported data as valid.

3.0 PROGRAMMING AND CALIBRATION

3.1 GENERAL

All user-entered operational parameters are stored in a non-volatile memory and are not affected by an AC power loss. Each parameter is accessed and its current value displayed by pressing the corresponding function key on the Controller faceplate. An operational parameter may be changed at any time by using the "Up" and "Down" arrow keys to scroll the display until the desired value is presented. Pressing the ENTER key then deposits the value into the program memory. If the optional printer is incorporated, a printed record is generated to provide a hard copy of the change. To exit a parameter or function display and retain the existing value, press the corresponding control or function key a second time. Pressing CLEAR at any time will exit the existing display and reinitiate an automatic analysis cycle without changing the existing value.

NOTE: There may be a momentary delay in presenting a display while the requested data is accessed.

3.2 CONTROLS AND INDICATORS

The Controller display (Figure 6) consists of various keys and LEDs to control and monitor operation of the unit. The control keys allow numeric entries as well as selection of the unit's operational mode. Controller displays and their respective functions are provided in Table 1.

NOTE: If an optional Interface Board is installed, the Clock/Calendar must initially be set (see Section 3.7.1).

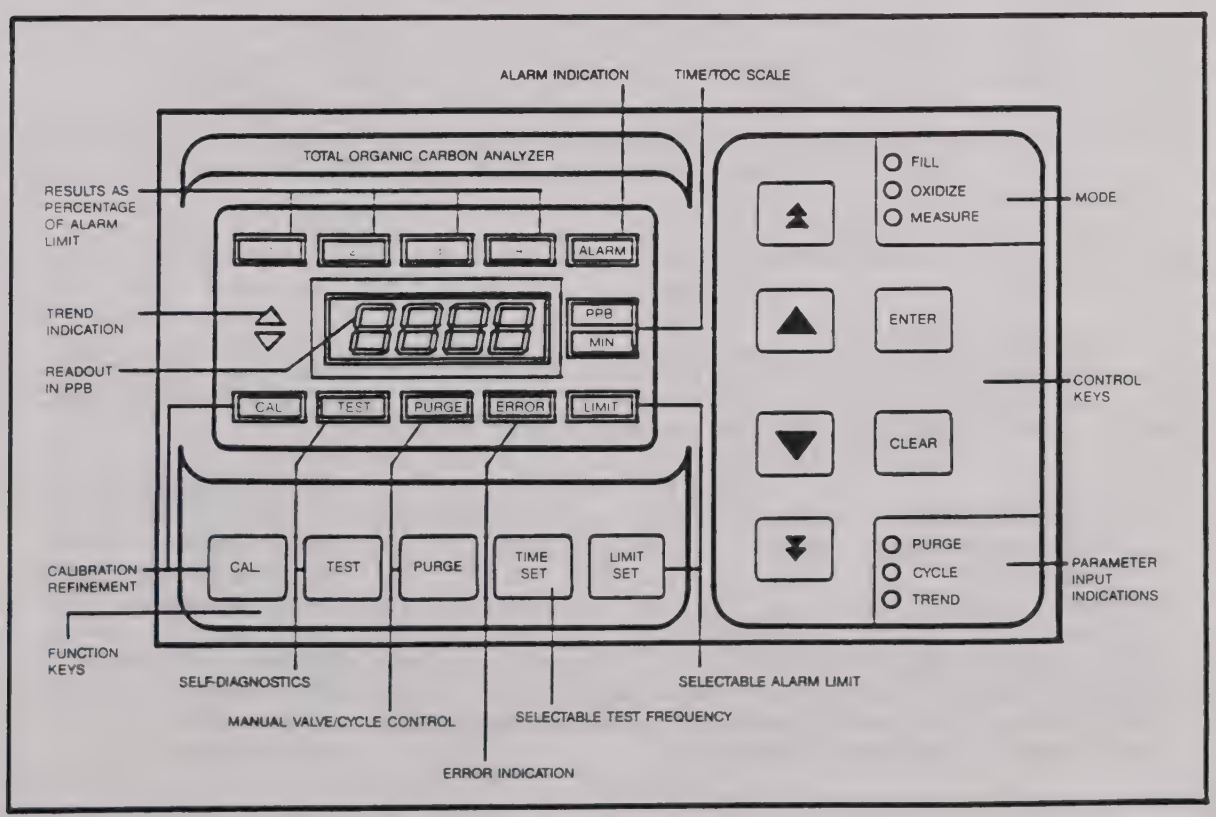


FIGURE 6 — CONTROLLER DISPLAY

TABLE 1 — CONTROLLER DISPLAY FUNCTIONS

CONTROL KEYS

"UP" Arrow — Increments display 5 digits (or .1 min)/second.
Dual "UP" Arrow — Increments display 100 digits (or .5 min)/second.
"DOWN" Arrow — Decrements display 5 digits (or .1 min)/second.
Dual "DOWN" Arrow — Decrements display 100 digits (or .5 min)/second.
ENTER — Deposits displayed value into the program memory.
CLEAR — Exits the current function and reinitiates automatic analysis.

FUNCTION KEYS

CAL — Although initially calibrated at the factory, this function allows the unit to be synchronized to a field standard.
TEST — Initiates the unit's Self-Diagnostic Mode.
PURGE — Manually opens the downstream valve to allow ultrapure water to purge the system. When in the Purge Mode, the unit will display both the resistivity (in Megohm-cm) and temperature (in °C) of the sample water.
TIME SET — Defines three independent timing parameters (Purge, Cycle and Trend) for the automatic mode of operation.
LIMIT SET — Defines the TOC alarm setting in ppb.

LED DISPLAYS

4-Segment Bargraph — Indicates TOC as a percentage of the alarm limit in 25% increments.
ALARM — Indicates the alarm limit has been exceeded.
Trend Indicator — Indicates an upward or downward trend in TOC level over a specified time interval.
Digital Display — Presents TOC (in PPB) in the Automatic Mode and temperature (in °C) and resistivity (in Megohm-cm) in the Manual Mode, as well as displaying numeric error code values.
CAL — Indicates the unit is in the Calibration Mode.
TEST — Indicates the unit is in the Self-Diagnostic Mode.
PURGE — Indicates the unit is in the manual Purge Mode.
ERROR — Indicates one or more error conditions have been detected. They may be displayed by pressing the TEST key.
LIMIT — Indicates the unit is in the Limit Set Mode.

3.3 DEFAULT VALUES

All parameters are loaded with factory default values which can then be altered to customize operation of the unit to the specific application. The factory installed default values are:

Parameter	Default Value
Timing Intervals	
Purge Mode	1.0 Minute
Cycle Mode	0.0 Minutes
Trend Mode	60.0 Minutes
Alarm Limit	100 ppb
Calibration Scaling Factor	1.0
Analog Output (Optional Feature)	4-20 mA
Full-Scale Analog Output (Optional Feature)	1000 ppb
Baud Rate (Optional Feature)	1200 Baud

Once altered, a factory default value may be restored by depressing the appropriate key to access the function, then pressing it again and holding it until the default is displayed (about 10 seconds). Pressing the ENTER key will redeposit the default into memory. The default values for all parameters may be reentered by turning the unit "Off," holding down the Dual "Down" key and then restoring power. Releasing the ENTER key will then redeposit all default values and the unit will return to its automatic analysis mode.

3.4 TIMING INTERVALS

The TIME SET key accesses three operational time intervals:

PURGE MODE (Default Value — 1.0 Minute)
Purge specifies the time that the solenoid control valve remains open prior to oxidation to allow rinsing and cleaning of the sensor. The Purge time should be increased if the sample line is longer than the standard five feet or if the sample is at a low flow rate. Maximum Purge time is 15.0 minutes; any attempt to enter a longer interval will default to this value.

CYCLE MODE (Default Value — 0.0 Minutes)
Cycle is the time from the beginning of one measurement cycle to beginning of the next successive cycle. If the Cycle time is set to a non-zero value, the unit will enter the Manual Mode (see Section 4.3) when the Measure operation has been completed. The valve will remain open and the Purge LED will flash until it is time to start the next analysis cycle.

TREND MODE (Default Value — 60.0 Minutes)
Trend is the time over which an increase or decrease in TOC levels is monitored and subsequently reported by an up or down indication. To be accurate, a trend should span at least four cycles. A trend is established by determining the slope of the TOC readings over the specified time. The slope is determined by a linear least squares fit over the last "n" minutes, where "n" is the trend time. If the absolute value of the slope exceeds an internal criteria, the resulting trend is indicated by illuminating the appropriate arrow.

The TIME SET key steps through these three time parameters, allowing the user to review and, if desired, change any of the existing values. A displayed time may be retained by simply pressing the TIME SET key. To review or change any of these values:

1) Press the TIME SET key to access the timing function. The small red PURGE LED will illuminate and its corresponding value will be displayed in MINutes.
2) Using the "Up" and "Down" arrow keys, change the displayed time to the desired value and ENTER it into memory. To retain the existing Purge Time, simply press the TIME SET key.
3) With the Purge Time entered, the CYCLE LED will illuminate and its corresponding value will be displayed. Again, ENTER a new value if desired or accept the displayed value.
4) Next, select the TREND interval. Retain the displayed value by pressing the TIME SET key or use the "Up" and "Down" arrow keys to change the existing value. Deposit the desired Trend interval by pressing the ENTER key. Once the Trend value is entered, the unit will return to its automatic analysis mode.

3.5 ALARM LIMIT (Default Value — 100 ppb)

The LIMIT SET key is used to define the TOC limit (in ppb) at which the ALARM indicator on the Controller illuminates. In addition, the bargraph display reports the percentage of alarm value in 25% increments. For example, if the selected alarm limit is 100 ppb and the current TOC measurement is 62 ppb, segments 1, 2 and 3 of the bargraph will be illuminated, indicating the TOC level is between 50% and 75% of the selected alarm limit. With the optional printer, the exact percentage is reported on the printout. Note that resistivity and temperature do not have alarm indications.

Additionally, with the optional Interface Board installed, the A-100 is equipped with a set of dry relay contacts. These alarm contacts can be set as Normally Open or Normally Closed, depending upon the configuration of the output wiring (see Section 7.1). These contacts are activated if the specified TOC limit is exceeded, allowing the operation of an external (user-supplied) alarm. For instance, in control applications the alarm contacts can be used to activate a circuit which closes a valve, stopping flow in a process line. The valve will remain closed until the TOC level again drops below the set alarm limit.

To change the alarm limit from the factory default value of 100 ppb:
1) Press the LIMIT SET key to access this function.
2) Using the "Up" and "Down" arrow keys, scroll the display to the desired value.
3) Press the ENTER key to deposit the displayed value into memory.

3.6 CALIBRATION (Default Value — Scaling Factor of "1.0")

The Anatel A-100 Organics Analyzer is delivered with precise calibration. It is designed for long-term operational stability and should not require frequent recalibration. However, should recalibration be desirable or necessary, Anatel makes precision calibration devices available: contact your Anatel representative for details.

The Calibration Mode can be used to synchronize the A-100 with any given analysis application, such as other A-100s, a calibration unit or an independent measuring device. To accomplish this relationship, a variable scaling factor or multiplier is used. This scaling factor is multiplied by the internally calculated TOC value and the resultant ppb value is displayed.

When the CALibration key is pressed, the current TOC value will be displayed. Entry of a new TOC value by the user causes the scaling factor to automatically change to reflect the desired reading.

CAUTION: FOR BEST RESULTS, DO NOT ARBITRARILY RECALIBRATE THE SET SCALING FACTOR WITHOUT SUFFICIENT REASON

For example, if the current reading is 54 ppb and the user wishes to recalibrate to 50 ppb:
1) Press CAL and 54 PPB will be displayed.
2) Press the "Down" arrow key until 50 PPB is displayed.
3) Press ENTER to deposit the new value. If incorporated, the optional printer will generate a record of the change to "50."

Assuming the previous scaling factor was the factory default value of "1.0," the effect of recalibration was to enter a new scaling factor of 0.9259259 (50/54). This new scaling factor will be applied to all subsequent TOC calculations until it is again changed, or the default of "1.0" restored, by the user.

NOTE: The A-100 must have completed at least one analysis cycle and display a TOC value before a calibration adjustment can be made.

3.7 SPECIAL FUNCTION PARAMETERS

The following parameters access special A-100 functions including the time and date, analog output values and the baud rate for the RS-232 interface. These parameters control the unit's output to any connected external devices and require the optional Interface Board (see Section 5.6). To access the Special Functions Mode:

1) Turn the A-100 Analyzer "Off." Current TOC and last trend period data will be lost.
2) While holding down the Dual "Up" Arrow key, restore power to the unit. Release the key and the bottom row of function lights will illuminate to indicate the unit is in the Special Functions Mode.
3) To exit this mode and return the unit to its normal analysis cycle, simply turn the Power Switch "Off" for a few moments and then restore power once again.

3.7.1 REAL-TIME CLOCK/CALENDAR SETTINGS

The unit's internal clock and calendar must initially be set to syncronize operation of the A-100 with other devices, as well as with real anatomical time. To set the clock and calendar:

1) Access the Special Functions Mode as outlined above (Section 3.7).
2) Press the TIME SET key. The fourth segment of the bargraph will illuminate, indicating that the clock/calendar parameter has been accessed. In addition, the red FILL LED will illuminate and the display will present the year.
4) Set the year by using the "Up" and "Down" Arrow keys to scroll the display. When the current year (indicated by its last two digits) is displayed, press ENTER to deposit it into the program memory. The FILL LED will extinguish and the OXIDIZE LED will illuminate, prompting for the current month.
5) Again use the arrow keys to scroll to the current month and ENTER it into memory. The MEASURE LED will then illuminate, requesting the date.
6) Select the current day of the month and ENTER it. The PURGE LED will then illuminate.
7) Set the current hour of the day (based on a 24-hour clock) and then ENTER it into memory. For example, 2:00 PM would be entered as "14."
8) Finally, the CYCLE LED will light, prompting for the minute. Set the current minute and ENTER it. The A-100 will then return to the Special Functions Mode.

REAL-TIME SETTING	CORRESPONDING LED
Year	Fill
Month	Oxidize
Day	Measure
Hour	Purge
Minute	Cycle

3.7.2 ANALOG OUTPUT (Default Value — 4-20 mA)

The Analog Output generates a signal corresponding to the current TOC reading with an output range, specified at the time the A-100 Analyzer is ordered, of either 4-20 mA or 0-5 VDC. When an analysis cycle is completed, an analog output signal will be generated proportional to the TOC reading. This output signal may be used for process control operations or to drive other external devices. Upon completion of an analysis cycle, the analog output signal is adjusted to correspond to the new TOC reading. The signal is maintained until the next analysis cycle is completed and a new output value has been calculated.

FULL-SCALE ANALOG OUTPUT (Default Value — 1000 ppb)

The full-scale analog function is used to alter the output resolution of the analog signal. The existing full-scale analog output (20 mA or 5 VDC) corresponds to the displayed value. For example, a full-scale analog output value of 500 would correspond to a 20 mA (or 5 VDC) output. Thus, a reading of 500 ppb would generate an analog output of 20 mA (or 5 VDC); a reading of 501 ppb would generate an overrange indication.

To set the full-scale analog value:

1) Turn the A-100 Analyzer "Off."
2) While holding down the Dual "Up" Arrow key, turn the power "On." Release the key and the bottom row of lights will illuminate to indicate the unit is in the Special Functions Mode.
3) Press the CALibration key. The first bargraph light will illuminate, indicating the full-scale analog output parameter.
4) Using the "Up" and "Down" Arrow keys, scroll the display until the desired analog value, corresponding to a full-scale output of 20 mA or 5 VDC, is presented. This value can be anywhere in the range of 1 to 9999 ppb.
5) Press ENTER to deposit the displayed analog value. The unit will return to the Special Functions Mode.

3.7.3 BAUD RATE (Default Value — 1200 Baud)

The A-100 Organics Analyzer can communicate at baud rates of 300, 600, 1200, 4800 or 9600. To use the optional printer, however, the rate must be set at 1200 baud. Fixed Parity, Data Bit and Stop Bit values are provided below: they are not user-adjustable parameters.

Baud Rate	Parity	Data Bits	Stop Bits
300 - 4800	None	7	2
9600	None	8	1

To alter the baud rate:

1) Turn the A-100 "Off," hold down the Dual "Up" Arrow key and turn the unit back "On" to access the Special Functions Mode, indicated by the bottom row of LEDs.
2) Press the LIMIT SET key. The current baud rate value will be displayed.
3) Use the arrow keys to display the desired baud rate and then press ENTER to set the new rate. The A-100 unit will then return to the Special Functions Mode.

4.0 OPERATION

4.1 GENERAL

The A-100 is an online Total Organic Carbon (TOC) analyzer which continously conducts ultrapure water analyses. The water sample can be drawn from a pressurized water line, the base of a tank, a gravity-fed drain, a low-pressure faucet or any source of high purity water that will provide a flow sample for purge and fill functions. Online analysis eliminates many of the contamination problems normally associated with sample collection and handling such as loss of purgeable organics, container contamination and interference errors as a result of sparging and exposure. Once initialized, operation of the Anatel A-100 Organics Analyzer is continuous and fully automatic, with the water samples analyzed at the intervals defined by the user in Section 3.4.

CAUTION: DO NOT ALLOW THE FLOW PRESSURE TO EXCEED 100 PSIG OR WATER TO FREEZE INSIDE THE A-100 UNIT

4.2 AUTOMATIC OPERATION

Automatic analysis occurs in three stages—Fill, Oxidize and Measure. During analysis, the previous TOC reading and its associated trend indication will be displayed. When the analysis is complete, the display information is automatically updated.

During the initial step, the FILL LED on the display is illuminated, the downstream control valve is opened and the internal ultraviolet lamp is on. This allows pressurized water to purge the sample inlet line as well as rinse and clean the sensor chamber and its components. The duration of the Fill step can be specified (see Section 3.4) in order to ensure the sample analyzed is representative of the source.

At the start of the Oxidize step, indicated by its corresponding LED, the ultraviolet lamp is turned off and the control valve remains open for 10 seconds to measure the internal conductivity and temperature of the water sample. These measurements are stored in the unit's memory. The control valve is then closed to trap a new sample, the UV lamp is turned on and oxidation begins. Conductivity measurements are taken continuously during the oxidation process. The change in conductivity resulting from the oxidation yields the Total Organic Carbon (TOC) content of the sample. The OXIDIZE LED will flash intermittently during this step to indicate that the A-100 is operating properly.

At the conclusion of oxidation, all three of the LEDs (Fill, Oxidize and Measure) will be extinguished momentarily before the OXIDIZE lamp flashes up to three times to report the organic nature of the sample. The number of flashes corresponds to the following profile types:

Profile Type "1" — Easy to Oxidize
Profile Type "2" — Moderately Difficult to Oxidize (found only in low levels)
Profile Type "3" — Difficult to Oxidize (intermediate organic acids are formed)

During the MEASURE step, its LED is illuminated and the downstream control valve remains closed while TOC calculations are performed. As the unit awaits the next analysis cycle, the UV lamp is left on to clean the electrodes and maintain the lamp's operational environment. When all calculations have been performed, the results are reported on the Controller display and another analysis cycle begins once again with the Fill step. With the optional printer installed, the results of each analysis cycle will be reported on the printout.

4.3 MANUAL OPERATION

The Purge Mode is a means of manually interrupting the A-100's automatic analysis cycle. Pressing the PURGE key will place the unit into a continuous purge state, allowing the water to freely flow through the system. In this operational mode, pressing the Dual "Up" and "Down" Arrow keys will toggle the display between sample temperature and resistivity values, respectively. These values also will be reported each minute by the optional printer. Pressing the PURGE key once again will exit the manual mode and return the unit to its automatic mode.

4.4 OPTIONAL PRINTOUT

As noted, with the printer option, a printout is generated at the conclusion of each analysis that provides information on various elements of the cycle. A sample printout is shown in Figure 7; definitions of the printout headings are given in Table 2.

TABLE 2 — PRINTOUT HEADINGS

PARAMETER DATA	
LIMIT [PPB]	— The set Alarm Limit in ppb
PURGE [Min]	— The set duration of the Purge Mode in minutes
CYCLE [Min]	— The set duration of the Cycle Mode in minutes
TREND [Min]	— The set duration of the Trend Mode in minutes
CAL	— The set Calibration or scaling factor
LAMP [%]	— The intensity of the UV lamp as a percentage of its full power
REPORT HEADING	
TIME	— Time at which analysis was initiated
TOC [PPB]	— The actual TOC concentration in ppb
%AL	— The percentage of the alarm limit the TOC level represents ("*****" indicates alarm exceeded)
TREND	— The Trend of TOC concentration in ppb/hr over time: Positive Value — Increase in TOC level Negative Value — Decrease in TOC level STABLE — Change of less than 1 ppb/hr
RES	— System resistivity at 25° Centigrade
TEMP	— System Temperature in degrees Centigrade
TYP	— The organic Profile Type: P1 — Easy to oxidize P2 — Moderately difficult to oxidize P3 — Difficult to oxidize

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LIMIT [PPB]	PURGE [Min]	CYCLE [Min]	TREND [Min]	CAL	LAMP [%]
120	2.0	0.0	60.0	1.0	N/A

TIME	TOC [PPB]	%AL	TREND [PPB/hr]	RES @25C	TEMP	TYP
08:20	4.4	3.6%		16.7	20.8	P2
08:29	3.8	3.2%		16.8	20.9	P2
08:38	4.0	3.3%		16.5	21.0	P2
08:46	4.1	3.4%		16.4	21.0	P2
08:54	4.3	3.6%		16.5	21.1	P2
09:02	4.4	3.7%		16.4	21.1	P2
09:11	4.6	3.8%		16.3	21.2	P2
09:19	4.6	3.8%		16.3	21.2	P2
09:27	4.7	3.9%	STABLE	16.4	21.2	P2
09:36	4.9	4.1%	STABLE	16.3	21.3	P2
09:45	4.9	4.0%	STABLE	16.3	21.3	P2
09:53	5.0	4.1%	STABLE	16.3	21.4	P2
10:01	5.1	4.2%	STABLE	16.4	21.4	P2
10:10	5.1	4.2%	STABLE	16.2	21.5	P2
10:19	5.2	4.4%	STABLE	16.2	21.5	P2
10:28	5.2	4.3%	STABLE	16.3	21.5	P2
10:36	5.3	4.4%	STABLE	16.2	21.5	P2
10:44	5.5	4.6%	STABLE	16.1	21.5	P2
10:53	5.7	4.7%	STABLE	16.2	21.5	P2
11:01	5.5	4.6%	STABLE	16.1	21.5	P2
11:10	5.6	4.7%	STABLE	16.1	21.5	P2
11:19	5.7	4.7%	STABLE	16.1	21.5	P2
11:27	5.7	4.7%	STABLE	16.2	21.5	P2
11:35	5.9	4.9%	STABLE	16.4	21.5	P2
11:44	5.9	4.6%	STABLE	16.4	21.5	P1
11:52	6.0	5.0%	STABLE	16.5	21.5	P1
12:01	5.9	4.8%	STABLE	16.5	21.5	P1
12:09	9.7	8.1%	7.6	16.4	21.5	P1
12:17	10.3	8.7%	4.1	16.4	21.5	P1
12:26	10.6	8.8%	4.1	16.4	21.6	P1
12:34	10.7	8.9%	4.2	16.4	21.6	P1
12:43	10.9	9.0%	4.2	16.3	21.6	P1
12:51	10.8	9.0%	4.3	16.4	21.7	P1
13:00	10.8	9.0%	4.2	16.6	21.8	P1
13:08	10.9	9.0%	4.4	16.6	21.9	P1
13:16	11.0	9.2%	4.1	16.4	22.1	P1
13:25	11.1	9.3%	STABLE	16.0	22.3	P1
13:33	11.2	9.3%	STABLE	15.6	22.5	P1
13:42	11.3	9.4%	STABLE	15.4	22.6	P1

FIGURE 7 — SAMPLE PRINTOUT

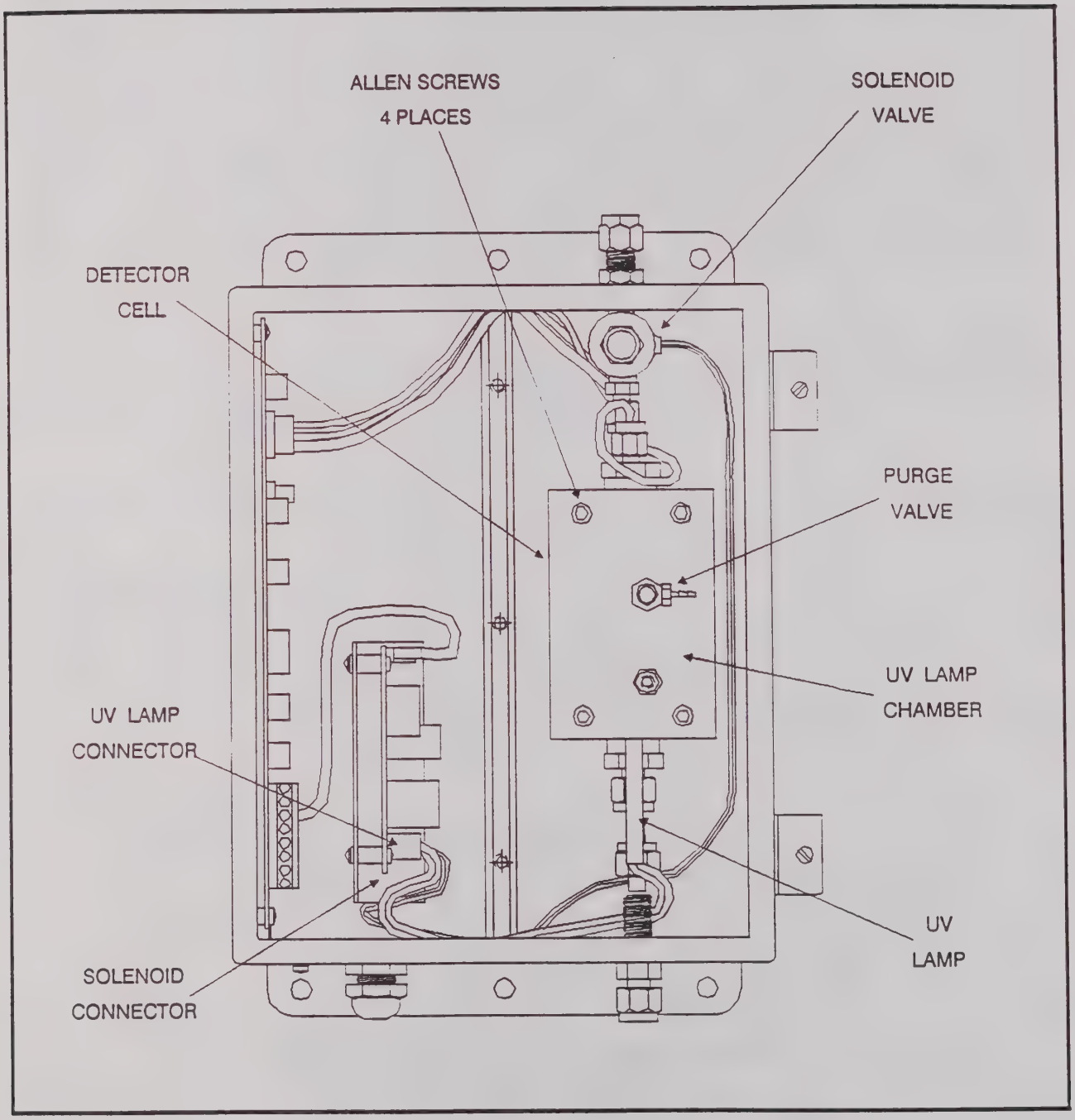

FIGURE 8 OPEN SENSOR COMPARTMENT

5.0 MAINTENANCE

5.1 GENERAL

Periodic maintenance procedures should be performed to assure accurate and proper operation of the A-100 Organics Analyzer. These procedures include testing the display, replacing the UV lamp and, if incorporated in the system, cleaning the printer and chart recorder mechanisms. If a problem exists, refer to Section 6.3 for additional information on troubleshooting. If the problem persists, contact Anatel or an authorized service representative for assistance.

NOTE: Contact Anatel for a return authorization before sending any equipment to the factory.

5.2 SELF-DIAGNOSTIC TEST

The A-100 should occassionally be run through its Self-Diagnostic Mode to assure proper operation. To initialize this operation, press the TEST key. Any detected errors will be reported on the Controller display (see Section 6.2 for specific Error Code information). Upon completion of the Test function, all LEDs and display segments will be momentarily illuminated to verify they light before the unit initiates an automatic analysis cycle.

5.3 ULTRAVIOLET LAMP (Anatel Replacement Kit P/N FG/60000)

The ultraviolet lamp should normally be replaced at least every six months to assure proper oxidation of the sample and accurate analysis results. The lamp should also be replaced if self-diagnostics indicate its failure or if the time required for oxidation increases suddenly and remains significantly longer than usual. To replace the UV lamp:

1) Turn power to the A-100 Analyzer "Off" and unplug the power cord.
2) Loosen the two securing clamps and open the Sensor Compartment.
3) Remove the brown plastic splash shield by gently squeezing its right rear side to pop it from its channel.
4) Disconnect the ultraviolet lamp plug connector (see Figure 8) by depressing the latch on its underside and pulling it straight out.
5) Loosen the four Allen screws on the UV lamp chamber cover. Allow the gasket to relax for 5 - 20 minutes before attempting to remove the chamber cover and access the lamp (see Figure 9).

CAUTION: THE GASKET WILL RELAX ALLOWING THE COVER TO BE REMOVED — DO NOT USE TOOLS OR ATTEMPT TO PRY THE LAMP CHAMBER OPEN

6) Remove the used UV lamp and gasket and discard them.
7) Install the new UV lamp and gasket (see Figure 10), being careful not to touch the glass or the fused silica window at the bottom of the chamber. Ensure that the dark bar visible at the end of the UV lamp is parallel to the bottom of the chamber (see Detail A-A). If it is accidentally touched, wipe the lamp surface with a particle-free cloth soaked in methyl alcohol to clean it. Allow the alcohol to evaporate before reinstalling the lamp.

CAUTION: DO NOT LET THE TIP OF THE LAMP TOUCH THE METAL HOUSING AND DO NOT TOUCH THE SENSITIVE GLASS OF THE REPLACEMENT LAMP OR IT WILL BECOME CONTAMINATED

8) Replace the lamp chamber cover and secure it with the four screws.

After replacing the UV lamp, or any time it is opened, the lamp chamber must be purged with an inert gas in order to reduce the incidental absorption of ultraviolet light by oxygen. The purging aerosol (supplied with the UV Lamp Replacement Kit) is low oxygen, low hydrocarbon nitrogen. The purge should last the life of the lamp under normal operating conditions. To purge the lamp chamber:

9) Attach the aerosol container to the nipple on the purge valve (see Figure 8).
10) Open the purge valve (counterclockwise) and allow the gas to purge the chamber for approximately 10 seconds.
11) Close the purge valve and disconnect the container.

NOTE: Purging the lamp chamber will not use all of the aerosol gas. Save the container until the next UV lamp is installed in the event the lamp chamber must be reopened.

12) Record the current date on the UV Lamp Replacement Log located on the inside of the Sensor Compartment door.
13) Reconnect the UV lamp connector and replace the splash shield.
14) Close and secure the Sensor Compartment door.

5.4 SOLENOID VALVE

The solenoid valve should be backflushed if the flow appears to be obstructed and cleaned if the problem persists. If the solenoid valve frequently becomes clogged, a Prefilter Kit (Anatel P/N FG/20009-01) may be installed. To backflush the solenoid valve:

1) Verify that the A-100 Analyzer is "Off."
2) Turn off the sample water supply.
3) Reverse the input and output tubing connections and then restore the sample water supply.
4) Turn the unit "On" and place it in the manual mode by pressing the PURGE key. Allow the unit to backflush for several minutes.
5) With water pressure to the system still on, open and close the downstream valve several times by repeatedly pressing the PURGE key every few seconds.
6) Turn the sample water supply and the A-100 power "Off." Reconnect the inlet and outlet tubing properly.

If the outlet tube continues to drip throughout the Oxidation step after the unit has been backflushed, the solenoid valve must be cleaned. To clean the solenoid valve:

1) Close the isolation valve, stopping the sample flow to the unit.
2) Press the PURGE key to open the sensor's solenoid valve and place the A-100 into the manual mode of operation.
3) Disconnect both the inlet and outlet tubing and allow the water to drain out of the unit.
4) Turn the A-100 Power Switch "Off" and unplug the power cord.
5) Loosen the two clamps and open the unit's Sensor Compartment.
6) Cover the detector cell (see Figure 8) with a paper towel in order to protect it from any water which may drip on it when the solenoid valve is removed.
7) Remove the splash shield by gently squeezing its right rear side to pop it from its track.
8) Referring to Figure 8, locate the solenoid and unplug its connector.

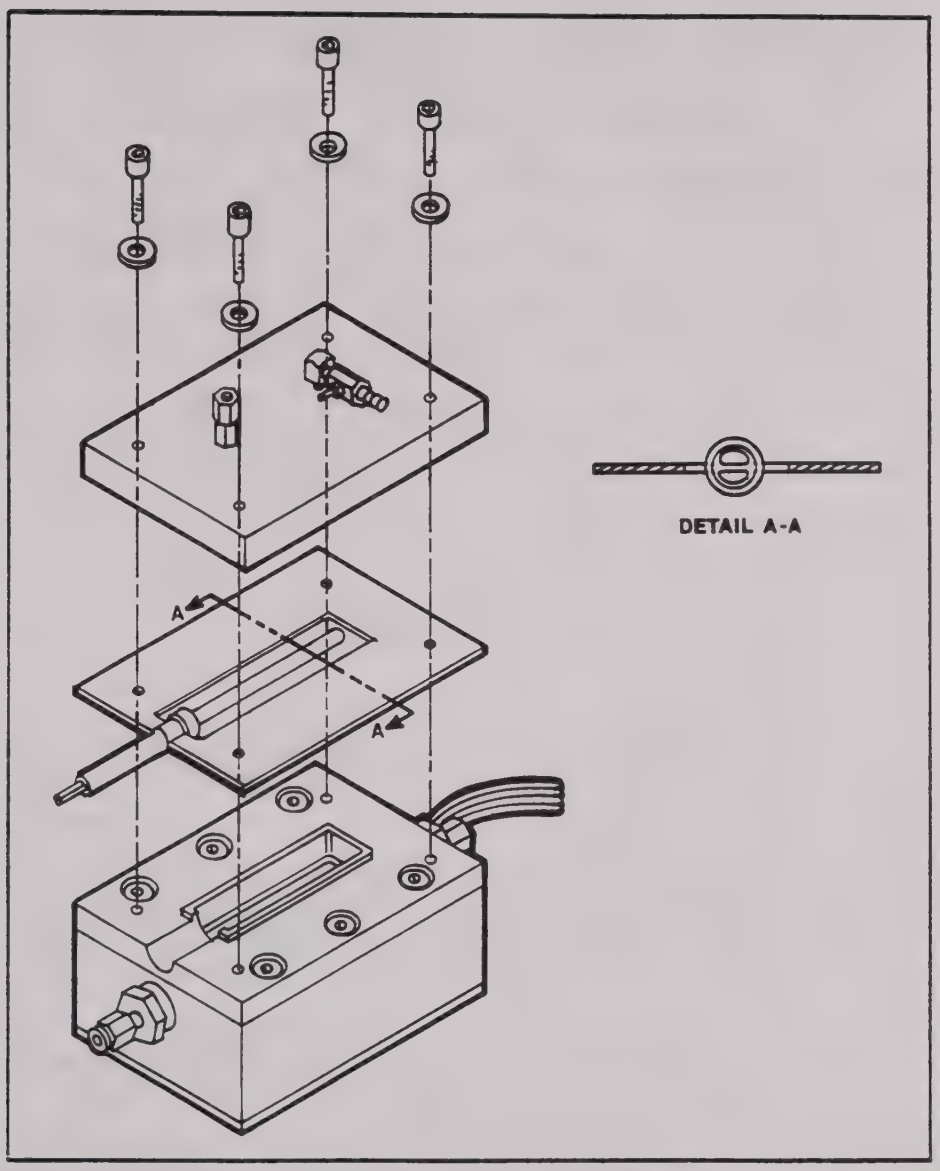

FIGURE 9 — OPEN ULTRAVIOLET LAMP CHAMBER

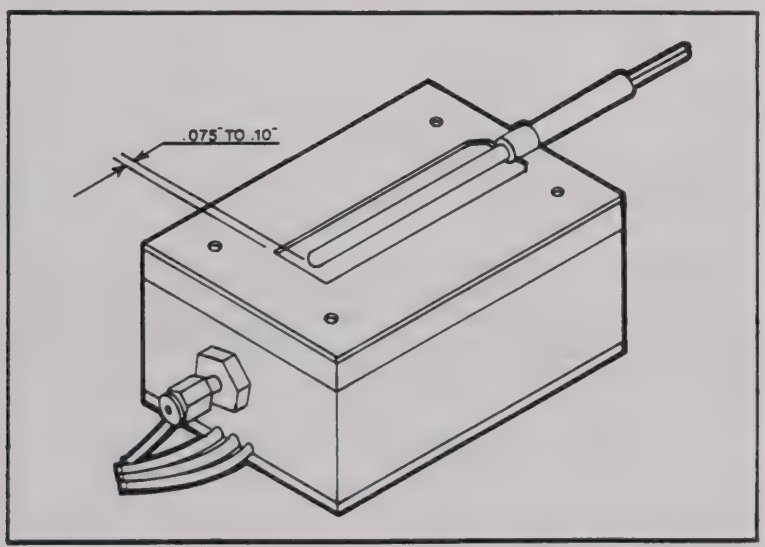

FIGURE 10 — ULTRAVIOLET LAMP REPLACEMENT

9) Grasp the valve firmly and, while pressing down, turn it counter-clockwise. Continue to unscrew the valve until it can be removed from the Sensor Compartment as one piece.

CAUTION: DO NOT DISASSEMBLE THE SOLENOID ELECTRICAL COIL

10) Remove any dirt and particles lodged in the bottom of the valve and its screw-in base.
11) Replace the valve in its base and screw it on hand-tight.
12) Reconnect the solenoid connector and replace the splash shield.
13) Reconnect the tubing and power connections and restore flow and power to the unit. Check for leaks and correct as necessary.
14) Turn the unit "Off," close and secure the Sensor Compartment.

5.5 POWER SWITCH LAMP (Anatel Replacement Kit P/N FG/50004-01)
Replacement of the On/Off Power Switch lamp is an easy process:
1) Verify that the Power Switch is "Off" and unplug the power cord.
2) Expose the lamp by pulling off the red plastic cap on the front of the Power Supply compartment.
3) Using a pair of needlenose pliers, carefully remove the Power Switch lamp by pulling it straight out.
4) Replace the lamp with one of equivalent rating, replace the red plastic cap and reconnect the power cord.

5.6 INTERFACE BOARD OPTION
This option allows external devices like the printer, chart recorder or a host computer to interface with the A-100 Analyzer. It also enables the operation of an external alarm contact relay. The A-100 may be ordered with the Interface Board or it may be installed later.
To install the Interface Board:
1) Verify power to the A-100 is "Off" and unplug the power cord.
2) Disconnect the cable(s) on the rear of the Controller and remove it from its mount by removing the four screws which secure it.
3) Place the Controller face-down on a clean, non-scratching surface so that the rear panel is facing upwards.
4) Remove the screws on each side of the TO POWER SUPPLY connector.
5) Remove the four acorn nuts and washers securing the rear panel. These nuts are attached to rods which extend all the way through the housing to the Controller faceplate.
6) Lift the rear panel, with the screw rods, off the Controller.
7) With the Controller standing upright, hold the faceplate and slide the main housing up and off. Be extremely careful not to damage the flexible connector between the faceplate and the motherboard.
8) The Interface Board is installed in the Controller with the DB-25 output connector to the rear. Match the 50-pin connector on the bottom of the Interface Board to its mate on the motherboard and gently press the two boards together. Be sure all of the pins are properly aligned and be careful not to bend or damage them.
9) Secure the Interface Board to the motherboard with the three screws provided. Two screws attach to the black heat sink bar on the rear and one to the standoff located along one side of the board.
10) Carefully slide the Controller housing over the two boards. The motherboard should be inserted into the third slot on each side of the housing or the boards may not align properly. Again, be careful not to damage the flexible connector.

11) Remove the blank covering the **OUTPUT** slot on the rear panel.
12) Stand the Controller on its faceplate and replace the rear panel by inserting it and the screw rods into the housing.
13) Recheck the alignment of the components before tightening the four acorn nuts and the two phillips screws. If the output connectors do not align with the holes provided in the rear panel, repeat the reassembly procedure.
14) Remount the Controller in its panel and reconnect the cable(s).

TI# 4002757-0001

5.6.1 LITHIUM BATTERY (Anatel Replacement Kit P/N FG/50011-01)
The lithium battery, located inside the Controller on the Interface Board, maintains the current time and date. It may grow weak over a period of time and have to be replaced to assure its backup capability. The battery may be checked using a standard voltmeter. A voltage of 3.0 VDC is normal. If the voltage is less than 2.5 VDC, a new battery should be installed. To replace the battery:
1) Verify that power to the A-100 is "Off" before removing the cable on the rear of the Controller.
2) Remove the Controller from its mount and disassemble it as outlined in Section 5.6 above.
3) With the Controller disassembled, locate the lithium battery on the Interface Board.
4) Remove the used battery, being careful not to damage the metal tab which holds it in place, and discard it.
5) Install the new battery positive (printed) side up.
6) Reassemble the Controller as described in Steps 10 - 14 above.

5.7 OPTIONAL PRINTER
The optional thermal printer is self-contained in its own compartment. Apart from periodic cleaning and inspection, the only printer maintenance requirement is replacing the paper roll. Anatel supplies replacement rolls in boxes of ten: consult your sales representative for larger quantities.

5.7.1 Paper Replacement (Anatel P/N FG/50000-01, 10 rolls)
A low paper supply is indicated when a red stripe appears along one edge of the paper: when the green LED on the printer faceplate turns red and flashes, the printer is out of paper. To replace the paper:
1) Verify the printer is turned "Off" and its power supply disconnected before removing the cables on the rear of the unit.
2) Turn the knob on the bottom of the printer faceplate counterclockwise to release its latch. The entire printer mechanism (Figure 11) can then be removed from its housing by pulling it forward.
3) Release the hold bar and remove the used paper roll.
4) Insert the new paper roll in the mechanism and replace the hold bar. Note that the print head must be in the "home" position.
5) Cut the leading edge of the paper to form approximately a 30° angle. Also cut about 3/4" off the tip to form a tab so the paper will feed more easily.
6) Turn the thumbwheel upwards to feed the paper through the printer until it exits the printer faceplate.
7) Replace the printer mechanism in its compartment and secure the latch by turning the knob clockwise.
8) Reconnect the cables and restore power to the printer.

* Paper must feed off the top of the roll →

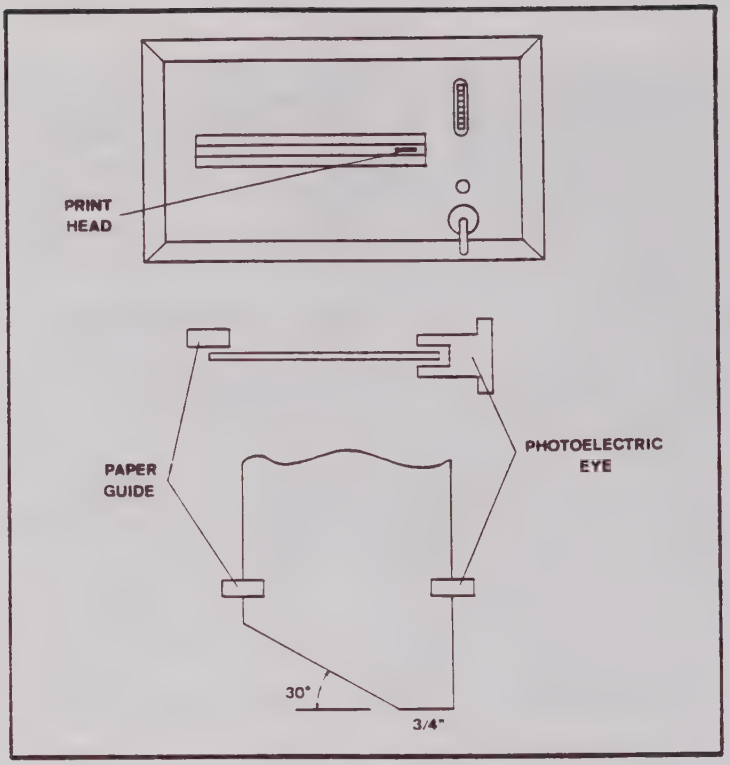

FIGURE 11 — PRINTER MECHANISM

5.7.2 Printer Maintenance

Periodic cleaning and inspection of the printer depends both upon the environment in which it is operating and the frequency of its use. Generally, maintenance should be performed yearly if the unit operates in a clean environment and use is light, monthly under medium usage and weekly under heavy usage or when subjected to a dirty environment. To clean the printer:

1) Verify that power to the printer is "Off" before disconnecting the cables from the rear of the unit.
2) Turn the knob on the bottom of the printer faceplate counterclockwise to release the latch and remove the entire printer assembly.
3) Thoroughly clean all moving parts on the printer mechanism using alcohol and cotton swabs. Clean any additional dirt from electrical components using compressed air or a soft brush.

CAUTION: DO NOT USE CLEANING SOLVENTS — THEY MAY DAMAGE PRINTER COMPONENTS

4) Lubricate the main cam, head shaft and drive gears with lubriplate. If the unit is operating in cold conditions, lubricate the parts with Silkon 35. To lubricate the main cam, remove the retaining clip from the head carrier and force the lubricant into the gallery in the carrier. Be sure to replace the retaining clip.
5) Replace the printer mechanism in its compartment, reconnect the cables and restore power to the unit.

The printer should also be inspected periodically to assure reliable operation. Check the printer head for ease of movement along the drive cam and shaft and make sure the paper feeds freely and does not catch on any parts. Inspect all wires and connections for damage and look for any loose or missing screws. For additional information on the printer, refer to the accompanying manufacturer's manual.

5.8 OPTIONAL ANALOG CHART RECORDER

The optional Analog Chart Recorder is a galvanometric device which converts a 4-20 mA signal into a 0-100% scale. The chart recorder uses pressure-sensitive paper and therefore requires no pens or ink. The only chart recorder maintenance is replacing the paper roll. A "Renew Chart" message appears along the edge of the last three feet of the roll. To replace the chart paper roll (refer to Figure 12 for parts identification):

1) Unplug the Chart Recorder power cord.
2) Open the unit by loosening the thumbscrew (1).
3) Unlatch the paper retaining clips (2).
4) Open the panel chassis latch (3) on the right side plate.
5) Remove the remaining chart paper (4) and take up the roller (5). If the paper is still attached to the roller, carefully slide the paper out from between the front panel and the chart drive.

CAUTION: DO NOT ATTEMPT TO PULL THE PAPER BACKWARDS THROUGH THE RECORDER — THE POINTER MAY BE DAMAGED

6) Insert the roller into the new supply of chart paper with the perforated edge nearest to the roller shoulder.
7) Unroll about a foot of chart paper and slide it between the panel and the side plate, sprocket holes first. Keep the paper taut and close to the drive drum to prevent damaging the pointer.
8) Engage the roller shaft into both seating notches (6) and check to be sure the paper perforations also engage the time drum sprockets.
9) Slide the cardboard sleeve onto the takeup disk and up against it.
10) Butt the paper against the disk and and tape the paper to the sleeve, printed side out. Wrap the paper a few turns to be sure it is started properly.
11) Continue rolling the paper and place the roller into the notches.
12) Close the clips, the latch and the recorder front panel. Secure it by tightening the thumbscrew.
13) Feed the paper using the advance wheel (8) to assure that it moves properly before setting it to the current time.

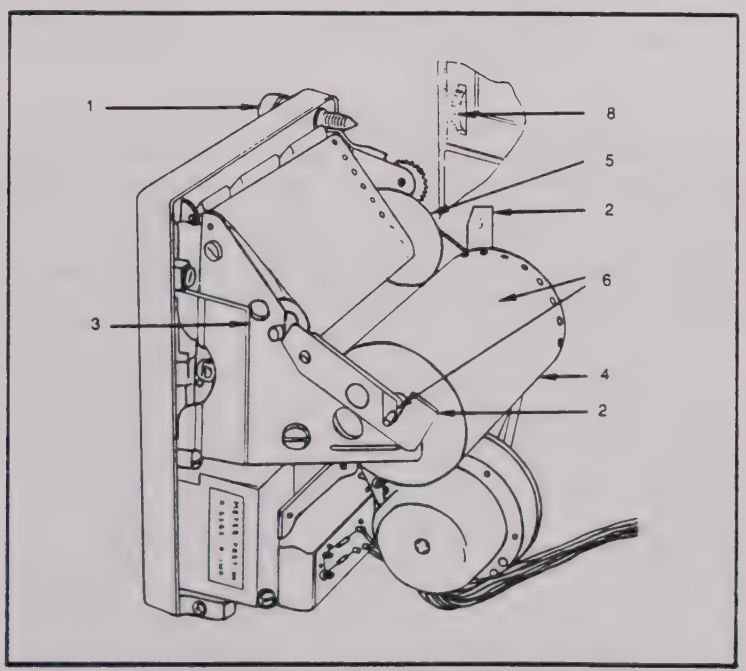

FIGURE 12 — CHART RECORDER PAPER REPLACEMENT

The recorder is shipped set to a chart speed of one inch per hour. If desired, this rate may be changed in the field by altering the drive gear train. Otherwise, the Chart Recorder has no user-serviceable parts. If the recorder malfunctions, check the paper feed and the power connections. Refer to the accompanying manufacturer's manual for additional information on troubleshooting the Chart Recorder.

NOTE: DO NOT attempt to disassemble the chart recorder as this will void the warranty. Contact Anatel for assistance or contact the manufacturer:

Graphic Instruments Division
Gulton Industries, Inc.
Gulton Industrial Park
East Greenwich, Rhode Island 02818
Telephone: (401) 884-6800

6.0 TROUBLESHOOTING

6.1 GENERAL

The A-100 continuously performs a series of diagnostic routines. During every analysis cycle, functional range and logic checks are examined to determine the operational status of the instrument. If one or more error conditions are detected, the appropriate error codes are entered into the program memory. If the optional printer is installed, the error and the time at which it is detected will also be reported on the printout.

6.2 ERRORS

One or more errors may be detected during self-diagnostic or analysis operations. The corresponding Error Code number may be displayed by pressing the TEST key. Definitions of these Error Code numbers are provided in Table 3. Any additional (different) existing errors may be displayed by subsequent pressings of the TEST key. Following display of the last logged error, the unit will return to its automatic analysis cycle.

NOTE: Individual errors are logged only once and are presented in a last in - first out order. As a result, they are erased from the unit's memory once they are displayed.

Errors fall into two classifications — Transparent and Interrupt.

Transparent Errors (Codes 1-7) serve as warnings to indicate operating conditions beyond the range specified for optimum performance. These errors do not illuminate the ERROR LED, nor do they interrupt the sample analysis cycle. Consequently, their presence is revealed only when the TEST key is depressed.

Interrupt Errors (Codes 10 and above) can be caused by instrument malfunction or by conditions which exceed the unit's operating range, and indicate the possibility that the test results may be inaccurate. When an Interrupt Error occurs the analysis is aborted, the ERROR LED is illuminated and the appropriate error code is logged into the program memory.

Computational results are still reported and a recovery is attempted by initiating a new analysis cycle. If the recovery is successful, the ERROR indication will be extinguished and normal operation will resume. The error, however, will remain logged in the program memory for examination. If the recovery attempt is unsuccessful, completion of the current sample analysis is prevented. The results of the most recent successful analysis are then displayed while the unit continues to attempt a recovery.

TABLE 3 — ERROR CODES

ERROR CODE	INDICATION
1	Raw Water Resistivity Less than 5 Megohm-cm at 25°C The recommended minimum sample resistivity to the instrument is 5 Megohm-cm. Although the instrument may perform well at much lower resistivity levels, this error alerts the user that the quality of the feedwater is below the unit's optimum performance range.
2	Inlet Temperature Less than 15°C
3	Inlet Temperature Greater than 40°C Incoming water temperature in the range of 15°C to 40°C is required for optimum performance. Although the instrument will continue to perform above and below the optimum range, these errors indicate that this range has been exceeded.
4	TOC Level Greater than 999.9 ppb The dynamic operating range of the A-100 is from 10 to 1000 ppb. Although the instrument will indicate values above and below this range, these readings are less accurate than TOC values that fall in the dynamic operating range.
7	Low Level Chemical Interference In some cases, the accuracy of the reported TOC value may be impacted by the presence of certain inorganic ions. This phenomenon occurs primarily in water with less than 5 Megohm-cm resistivity. The bias is more significant for TOC levels of less than 100 ppb. This error alerts the user that the TOC result should be regarded as a relative, rather than an absolute, value.
10	Conductivity Underrange In the event that the conductivity sensor measures less than 0.005 microsiemens, the instrument will abort the analysis and the ERROR LED on the Controller display will be illuminated. Such a failure could indicate a vacant sample chamber, in which case the sample flow to the A-100 should be examined. This error could also result from a malfunction of the conductivity sensor.
11	Conductivity Overrange During the oxidation of a sample, its conductivity will increase as a result of the oxidation process. Should the conductivity exceed 10 microsiemens (the upper limit of the detector), the analysis will be aborted. In most cases this error indicates an extremely high TOC level.
12	Temperature Underrange If the temperature sensor detects a temperature of less than 0.0025°C, the A-100 will abort the analysis. This error indicates the temperature sensor has failed and the factory should be consulted.

TABLE 3 — ERROR CODES

ERROR CODE	INDICATION
13	Temperature Overrange If the influent water temperature exceeds 50°C, the A-100 will abort the analysis, since at such temperatures the compensation calculation becomes invalid.
14	Oxidation Cycle Longer than 2000 Seconds During the oxidation process, the A-100 monitors the completeness of the reaction. In cases where oxidation is incomplete after 2000 seconds (33.3 minutes) the instrument will display the current TOC value and proceed with the subsequent analysis cycle. This error informs the user that the displayed TOC value is less than the absolute concentration. In most cases, it can be assumed that the absolute value is 10-20% higher than the displayed value.
16	Chemical Interference Preventing Accurate Reading This error relates to conditions similar to those described in Error Code "7." In the event the chemical interference is significant enough to cause an invalid TOC measurement, the A-100 will automatically abort the analysis run.
17	TOC Less than 0.1 ppb When the A-100 TOC response is less than 0.1 ppb, this error is used to indicate an instrument malfunction. The most common causes are an expended ultraviolet lamp or no flow through the instrument.
100	Head Communication Error This error occurs in the event the Controller is unable to communicate with the sensor head. The condition is characterized by an illuminated ERROR LED and flashing TEST LED. Verify that all cable connections are secure.
101	Computer Calculation Error This math calculation error typically occurs in cases where standard operating parameters, such as temperature and resistivity, are exceeded. Consequently, this condition is usually accompanied by one or more additional errors.
102 103	Controller RAM Error Non-volatile RAM Error Both of these errors typically appear as a result of electrical phenomena. The situation can often be rectified by turning power to the A-100 "Off" and then restoring power for a subsequent analysis cycle.

6.3 TROUBLESHOOTING

The common failure conditions listed in Table 4 are the only problems that may be addressed by the user. Any other failures should be referred to your Anatel service representative. The following information should be included in any correspondence:

- A-100 Serial Number
- Sample resistivity and temperature
- Current and historical TOC data
- Current and historical Error Codes
- Process resistivity and temperature
- Any noted drain flow during the Oxidize step
- Any other significant changes in operating conditions

DO NOT return any equipment to Anatel without a return authorization. If existing problems warrant return of the equipment, contact your Anatel representative. Be sure to include a return shipping address as well as shipping instructions.

Anatel Instrument Corporation
2200 Central Avenue, Suite F
Boulder, Colorado 80301
Telephone: (303) 442-5533

6.4 SELF-CLEANING MODE

It is possible that if the A-100 is placed on a very dirty water source the internal sensor cell may become contaminated. If, after relocating the instrument to a relatively clean application, excessively high TOC and low resistivity readings persist, the unit may have to be cleaned using the ultraviolet lamp to burn away existing sensor cell contamination. To place the unit in its Self-Cleaning Mode:

1) Turn the Power Supply Switch "Off."
2) While holding down the Dual "Up" Arrow key on the Controller, restore power. The unit will enter the Special Functions Mode, indicated by the illumination of the bottom row of LEDs.
3) Press the PURGE key to turn the UV lamp on and to initiate a continuous flow through the unit.
4) Run the A-100 in this Self-Cleaning Mode for 3 - 4 hours. Note that no temperature or resistivity values will be reported.
5) Press the PURGE key after Self-Cleaning to return the A-100 to the Special Functions Mode. Then turn the unit "Off" for a few moments and back on to reinitiate its automatic analysis mode.
6) If the problem persists after self-cleaning, consult the factory.

TABLE 4 — TROUBLESHOOTING GUIDE

SYMPTOM	CAUSE	CORRECTIVE ACTION
Unusually high resistivity (greater than 18.3 Megohm-cm)	Air in cell — watch for bubbles in the outlet line	Make sure that the Sensor Compartment is mounted vertically and that the inlet and outlet are plumbed correctly. Open and close the solenoid valve repeatedly to purge.
Unusually low or erratic TOC values	Inadequate sensor flushing	Increase the length of the Purge Cycle.
	Leaking solenoid valve — watch for flow during the Oxidize step	Backflush as outlined in Section 5.4 and purge the unit repeatedly.
No flow in the Purge Mode	Clogged solenoid valve	Backflush the valve and clean, if necessary, as described in Section 5.4.
Unusually long Oxidation period	Increase in system TOC level	Check sample supply.
	Faulty UV lamp	Replace the UV lamp (see Section 5.3).
Error Code "14" or "17" displayed continually (especially with low TOC values)	Faulty UV lamp	Replace the UV lamp. If the problem persists, contact Anatel.
ERROR LED displayed on power-up, or Error Code "100" reported	Interrupted communications from the sensor to the Controller	Check connections to the Controller. Also check connections between the Sensor Compartment and the Power Supply.
Temperature reading off by more than $\pm$5°C	No flow through the unit	Check flow rate in the Manual Purge Mode (see Section 4.3). Backflush and clean the solenoid valve (Section 5.4).
	Faulty temperature sensor	Contact Anatel.

7.0 CONTROLLER OUTPUT CONNECTOR

7.1 OUTPUT CONFIGURATION

With the optional Interface Board installed, the user may perform complete programming and reporting functions through a host computer. Communications are via a standard RS-232C serial port, with the baud rate adjustable from 300 to 9600 baud (see Section 3.7.3). The standard DB-25 connector is located on the rear of the Controller and has the following pin assignments:

PIN	ASSIGNMENT
2	TXD (Computer) Transmit
3	RXD (Computer) Receive
6	DSR (External Printer) Busy
7	RS-232 Ground
9	Analog (+)
10	Analog (-)
11	Relay (NC)
12	Relay (Com)
13	Relay (NO)
18	Shield (Ground)
20	DTR (Computer)

Computer Interface — A-100 transmits data on Pin 2, receives data on Pin 3 and looks for DTR on Pin 20. Pin 7 is Ground.

External Printer — A-100 transmits on Pin 2, looks for DSR on Pin 6 and Pin 7 is Ground.

Analog Output — Maximum load resistance for a current output is 350 ohms; minimum load resistance for a voltage output is 500 ohms.

Alarm Relay Contact Output — Can be set to "Normally Open" or "Normally Closed." The maximum load rating is 1 Amp at 24 VDC.

7.2 COMPUTER INTERFACE

7.2.1 Communications Protocol

The communications protocol for the A-100 Analyzer is set up to respond to both XON/XOFF and reverse channel (DTR) signals, allowing operation with a computer using either format. Since all commands are less than 15 bytes long (depending upon the value sent) and the buffer in the Controller will hold 30 bytes, the data can never be sent too fast to be processed. Commands sent to the A-100 consist of simple 2-letter ASCII mnemonics followed by one or more bytes of data and then a carriage return (<CR>) to indicate the end of the command. An optional line feed (<LF>) may be added if desired. Each command received by the A-100 unit will initiate a reply consisting of one or more bytes of data followed by a <CR> and <LF>. Mode commands do not require a numeric reply and simply return a <CR><LF>.

All values sent and received are in either ASCII or SNC (Super Number Cruncher, referring to the microprocessor contained in the A-100) format, depending upon the set mode. These data formats are:

ASCII MODE

Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
1	.		5	E	5	<CR>	<LF>

ASCII numbers are sent as they would be entered into a calculator, including negative values. For example, -1.23 may be entered as -1.23 or -123E-2.

SNC MODE

Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8	....	<CR><LF>
EXPH	EXPL	SIGN	ZERO	MANT1	MANT2	MANT3	MANT4	....	END

The first two bytes of the SNC mode form the exponent. The sign byte has the signs of both the mantissa and exponent. The mantissa sign is Bit "0" of the sign byte and the exponent is Bit "3." The decimal point always comes after the first mantissa digit. Thus, the number -12.345E6 is represented as:

30 37	31 30	31 32	33 34	35 30	<CR> <LF>
exp	sign	mant	mant	mant	

NOTE: All bytes sent are ASCII values.

7.2.2 Commands
Commands consist of data read, data set and mode set functions.

Data Read Functions
All data read functions return one value except for the time, error stack, run start time and run parameters functions. Each value is terminated with a <CR><LF>.

DATA READ

COMMAND	FUNCTION
RT	Read current Trend Time in minutes
RC	Read current Cycle Time in minutes
RP	Read current Purge Time in minutes
RD	Read current Temperature in °C
RR	Read current Resistivity in megohm-cm
RA	Read current TOC as alarm percentage
RL	Read current Alarm Limit in ppb
RF	Read current Calibration factor
RE	Read Error Stack — displays the error codes of any detected errors. Up to 5 errors may be displayed, each in SNC format, followed by a value of zero.
RS	Read Software Revision Number
RY	Read RTC Time and Date — displays 6 SNC values representing the real-time clock year, month, day, hour, minute and second
RO	Read last TOC Value in ppb
RV	Read current Trend Value in ppb/hour
RK	Read the value set for full-scale Dacout in ppb
RM	Read current DAC mode ("4" = 4-20 mA, "5" = 0-5 VDC)
RU	Read lamp intensity as a percentage — displays "999" if lamp sensor is not installed or set
RN	Read A-100 Serial Number
RJ	Read the current calibration factor for conductivity readings
RB	Read the Profile Type (1, 2, or 3) of the last completed run
RG	Read the start time of the current TOC run
RH	Read the elapsed time of the last completed run in seconds

RI	Read the run completed flag ("-1" if errors encountered, otherwise indicates the number of runs completed since last reading. Resets to "0" when read).
RQ	Read the parameter change flag (set to "1" when any parameter is reset from the front panel and resets to "0" when read).
RZ	Read the Start Time, Elapsed Time, TOC, Temperature, Resistivity and Profile Type, respectively, of the last completed run. A total of 8 values are displayed. This command ensures that these parameters are all from the same run.

Data Set Functions
All data set functions require one value except the set time function. If a negative value is used, the factory default value will be substituted, if applicable.

DATA SET COMMAND	FUNCTION
ST	Set Trend Time in minutes
SC	Set Cycle Time in minutes
SU	Set Purge Time in minutes
SF	Set Calibration factor
SL	Set Alarm Limit in ppb
SY	Set Time — requires six values representing year, month, day, hour, minute and second. Each entry should be followed by a <CR><LF>
SD	Set full-scale DAC output value in ppb
SO	Set the TOC Value (alters the Calibration factor)

Mode Set Functions
These functions are used to control the optional printer or analog output, or to set operating modes in the A-100.

MODE SET COMMAND	FUNCTION
MR	Reset all factory default values and restart the unit
MP	Enable output of standard printout to printer port
ML	Disable output of standard printout
MT	Enter Self-Diagnostic Test Mode
MG	Enter manual Purge Mode (valve open, UV light off)
MC	Enter Self-Cleaning Mode (valve open, UV light on)
MO	Start TOC readings and trend indication. Used to exit the purge or cleanup mode), also restarts the trend indication.
M4	Set DAC output to 4-20 mA
M5	Set DAC output to 0-5 VDC
ME	Clear the error stack
MQ	Terminate computer interface — all further computer inputs will be ignored until the unit is turned off and back on
MN	Set SNC number format (all numbers transmitted and received will be in the SNC format)
MA	Set ASCII number format (all numbers transmitted and received will be in the ASCII format)
MK	Disable all keyboard functions until the "MB" command is sent or the unit is turned off and back on
MB	Enable all keyboard functions

7.2.3 Operation

As noted, the Controller OUTPUT connector accepts a standard interface cable fitted with a DB-25 male connector, both of which must be supplied by the user. When using a computer, the printer output signal must initially be disabled using the "ML" command so that the only characters from the port will be responses to the commands issued from the computer. At this time, any desired setup commands should also be issued to define the A-100's operational parameters.

NOTE: The unit automatically installs the factory default values. No additional setup is required unless parameters must be altered.

Two commands ("MO" and "MR") will initialize analysis by the A-100. The "MO" command will interrupt current operation and initiate a TOC run. Since the run length varies, the unit must occassionally be polled for the end of the run. "RI" will access a flag which reports on the run status. The response will be "-1," "0" or a positive integer. A "0" indicates the run is still in progress and no errors have been detected. A "1" indicates one run has been completed, a "2" two runs, and so on. This provides and indication of how long it has been since the last readings were taken. After responding to the "RI" command, the run status flag will automatically be reset. A "-1" response to the run status inquiry indicates an error condition is present. An "RE" command will access the error code(s). Up to 5 error codes will be sent, each terminated by a <CR><LF> sequence. The last response sent will be a "0," followed by a <CR><LF>. These errors will remain logged on the stack; they are not cleared by being read. To clear them, an "ME" command must be issued.

The "RZ" command will provide the data from the most recent completed run. The block of data will contain the run start time, elapsed time, TOC, temperature and resistivity values and the profile type, respectively. The run start time is returned in hours, minutes and seconds, followed by the remaining five values. All eight pieces of data are terminated with <CR><LF>.

Several commands allow the real-time parameters to be read including "RD" (Temperature), "RR" (Resistivity), "RO" (TOC Value), "RB" (Run Profile Type), "RG" (Run Start Time) and "RH" (Run Elapsed Time). Each of these commands returns the most current value. Since some values are read at the beginning of the run and some at the end, care must be exercised in issuing these commands. For example, if the A-100 is polled every minute and a TOC value is received, the unit may already be on its next run. The previous values are still retained, so the report is mixing data from two runs and, therefore, is not accurate. The "RZ" command avoids this potential problem by returning only values from the last completed run.

The recommended polling time for the A-100 is once every 15 - 60 seconds. The unit must momentarily halt the TOC measurement cycle each time it receives a command. If polled too often, the time required for analysis will be extended; polling too infrequently might result in loosening some readings (as indicated by a reading of "2" or greater from the "RI" command). The latter condition will only occur if the poll time is longer than the run time. Typical run times range from 4 - 15 minutes, depending upon the type of organic present.

If the program written to interface the A-100 is not fast enough to keep up with the data being returned, it is recommended the XON/XOFF protocol be used by following each command with a XOFF character. The A-100 response will not be sent until an XON character is received. If interface problems arise, it is recommended that a properly configured terminal be directly connected to the CIF port. With a full-duplex terminal, both the commands and the responses will be clearly displayed on the screen, allowing the user to become familiar with the software.

NOTES:

TABLE 5 — INTERFACE COMMANDS

"DATA READ"

COMMAND	FUNCTION
RT	Trend Time
RC	Cycle Time
RP	Purge Time
RD	Temperature
RR	Resistivity
RA	% Alarm Limit
RL	Alarm Limit
RF	Calibration Factor
RE	Error Stack
RS	Software Revision
RY	Time and Date
RO	Current TOC
RV	Trend Value
RK	Dacout Full-Scale
RM	DAC Mode (4-20 mA/0-5 VDC)
RU	Lamp Intensity
RN	Serial Number
RJ	Conductivity Calibration Factor
RB	Run Profile Type
RG	Run Start Time
RH	Elapsed Run Time
RI	Run Finished Flag
RQ	Alter Parameter Flag
RZ	Run Parameters

"MODE SET"

COMMAND	FUNCTION
MR	Master Reset
MP	Printer Output "On"
ML	Printer Output "Off"
MT	Enter Test Mode
MG	Enter Purge Mode
MC	Enter Cleanup Mode
MO	Start TOC Readings
M4	Set 4-20 mA
M5	Set 0-5 VDC
ME	Clear Error Stack
MQ	Stand Alone Mode
MN	Set SNC Format
MA	Set ASCII Format
MK	Disable Keyboard
MB	Enable Keyboard

"DATA SET"

COMMAND	FUNCTION
ST	Trend Time
SC	Cycle Time
SU	Purge Time
SF	Calibration Factor
SL	Alarm Limit
SY	Time and Date
SD	Dacout
SO	TOC (Changes Cal)

MP MASTER
MA32264